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AN EXPERIMENTAL STUDY OF VARIOUS CHEMICALS USED IN PYELOGRAPHY[1]

OSWALD SWINNEY LOWSLEY AND HENRY R. MULLER

From The James Buchanan Brady Foundation for Urology, New York Hospital

Received for publication August 4, 1922

HISTORICAL REVIEW

Tuffier in 1897 and Schmidt and Kolischer in 1901 independently suggested taking X-rays with the course of the ureters outlined by means of a wire introduced into ureteral catheters. Lowenhardt in 1901 and Von Illyes in 1902 described similar methods. In 1905 Fenwick proposed the use of a metal impregnated bougie for the same purpose.

Solutions were first injected into the ureter and kidney pelvis by Klose in 1904, who used an emulsion of bismuth.

In 1906 Voelcker and Von Lichtenberg reported the use of collargol, a colloidal silver salt, in pyelography. Various other substances were suggested as follows: Keyes, 40 per cent argyrol in 1909; Uhle and Pfaler, silver oxide in 1910; Doderlein and Kronig, xeroform in 1913; Burkhardt and Polano, oxygen in 1907.

Kelley and Lewis in 1913 recommended silver iodide emulsion as proposed by Uhler and Pfaler. This proved to be quite serviceable although a nonviscid solution is preferable. In 1915 Braasch of the Mayo Clinic published an interesting book upon pyelography with 296 pyelograms. This publication was a very valuable contribution and served to stimulate interest in the subject.

Edward L. Young, Jr., of Boston published an article on April 15, 1915, advocating the use of argentide suspended in a mucilage made from macerated quince seed in water. Eisendrath,

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[1] Read before the American Urological Association, April, 1922.

Keyes and Spitzer had previously demonstrated the toxic nature of collargol. On June 26 of this same year J. Edward Burns reported the use of neutral citrate solution of thorium nitrate.

The last mentioned solution proved to be the most satisfactory that had yet been tried. Ordinarily it was nontoxic and usually cast shadows. The objections to its use were that the solution had to be made in a special manner, was very expensive and occasional bottles would be quite toxic and other samples would not cast a shadow. One death was reported after the use of thorium nitrate solution in taking a pyelogram at the Mayo Clinic.

In 1918 a new era in pyelography was opened by the suggestion of Cameron, who in March of that year proposed the use of sodium or potassium iodide in 25 per cent solution. He was under the impression that these two solutions could be used interchangeably but in later publications advocated the use of weaker solutions and correctly thought the use of sodium iodide to be preferable. In October of this same year, Weld, working in the Mayo Clinic, proposed the use of sodium bromide.

More recently Woodruff of New York has suggested bismuth and ammonium citrate 5 to 10 per cent and Eugene Joseph of Berlin has suggested acid free lithium iodide 20 per cent.

A most interesting development in radiography is the recent work of H. H. Carelli of Buenos Ayres. He proposed the injection of oxygen or CO_2 into the perinephritic space after which an X-ray is taken. This procedure was first performed by Carelli and later independently by Rosenstein at the Jewish Hospital in Berlin.

We have called the result of this method a roentgenogram. It produces a most interesting and instructive picture of the kidney and is particularly valuable where it is impossible to catheterize the ureter of the kidney in question. The gas introduced in the quantity of 200 cc., 600 cc. is absorbed within one and one-half hours and is not accompanied by the great pain which characterizes pneumoperitoneum.

In these experiments the various chemicals used were injected into beef kidneys. The kidneys were obtained from the abattoir immediately after slaughter and taken directly to the X-ray laboratory. The solution to be used was then injected into the kidney and X-rays taken with the calyces widely distended under pressure, which was maintained by clamping the ureter.

The chemicals used were as follows:

A. Sodium salicylate
B. Ammonium bromide
C. Iron pyrophosphate
D. Bismuth subnitrate—suspension
E. Potassium citrate
F. Argyrol 15 per cent
G. Ammonium bromide
H. Magnesium sulphate
I. Potassium iodide
J. Iron and ammonium citrate
K. Sodium bromide
L. Sodium chloride saturated solution
M. Thorium citrate
N. Sodium bicarbonate
O. Sodium iodide

An estimation of the opacity of the various substances tested is easily obtained by viewing the X-ray plates taken. It is noted that the substances used divide themselves into three groups: (*a*) those substances which cause insufficient shadow to be considered, such as: sodium salicylate, iron pyrophosphate, and potassium citrate. (*b*) Those drugs which cast a medium shadow, sodium bicarbonate, sodium chloride, magnesium sulphate, iron and ammonium citrate, chalk in suspension, argyrol 15 per cent; (*c*) solutions which cast a good shadow; bismuth in suspension, ammonium bromide, potassium iodide, sodium iodide, and the various well known substances including sodium bromide, thorium citrate, argentide and collargol.

It is interesting to note that the shadows cast by ammonium bromide 30 per cent and sodium iodide 20 per cent are as deep or deeper than those cast by bismuth subnitrate in suspension. Potassium iodide gives the best shadow of all. The solution is shown as it penetrates the small renal tubules leading away from the calyces and accurately demonstrates what happens when any solution is injected into the kidney under force.

The shadows cast by sodium bromide, thorium nitrate, argentide and collargol are so familiar that a description here is unnecessary.

After observing the opacity of the fluids to be used healthy young rabbits were anesthetized and one kidney removed through a lumbar incision for examination as a control. The ureter on the other side was then isolated and the kidney pelvis and upper ureter injected under sufficient pressure to cause the entire kidney to swell by introducing a hypodermic needle into the lumen of the ureter and injecting about 2 cc. under considerable pressure and continuing the pressure for at least five minutes. Our purpose in using so much force was to inject the solutions under the most unfavorable conditions possible in order to get the maximum effect.

It had previously been determined that a rabbit could live with approximately only one-quarter of one kidney remaining uninjured.

Sometime later, usually in two weeks, but often later, the animal was again anesthetized and the kidney removed or a wedge shaped piece taken out. The specimens were all preserved in formalin 10 per cent and then dehydrated, mounted in paraffine and sections cut and stained. Then they were subjected to careful microscopic study for evidences of permanent or temporary damage.

During the course of the experiments it was learned that rabbits live from two and one half to four days with both kidneys removed.

DISCUSSION

It was found that practically every kidney treated by the extreme pressure as described above showed cloudy swelling regardless of the type of solution used. This bears out the work of Daniel Eisendrath who found that 2.75 cc. of collargol injected under a pressure of 13 mm. Hg into a dog's ureter resulted in the finding of collargol in interstitial tissue of the medulla of kidney. At 32 mm. Hg. pressure resulted in marked inflammatory changes in medulla of dog's kidney, slight hemorrhages in lungs and spleen. Hemorrhages into interstitial tissue of kidney and glomeruli were found even when sterile water was injected so he thought this was due to trauma and not the collargol.

In series 1, collargol was injected not exceeding capacity of renal pelvis and only enough pressure to distend slightly. Practically no deposits and no damage to epithelium. Series 2, pressure and quantity increased, collargol found in kidney, lungs or both. One case in blood vessels of kidney. In animals that lived for some days evidence that some irritation had been present and caused intense inflammatory reaction. More severe effects of collargol and cargentos shown in rest of experiments.

too much fluid or pressure is used with any injection, it is forced into interstitial tissue and tubule and soon into blood vessels, is carried to lungs and causes embolism and death or acute pulmonary edema, hemorrhagic infarct of lung.

By the above references and our own experiments on rabbits it is apparent that extreme pressure with overdistention of the kidney is a dangerous procedure just from the mechanical effect.

The toxicity of the material used is of great importance because Burns, Weld and Cameron have all shown that the kidney pelvis absorbs substances rapidly. The last found that a dog kidney pelvis filled with molar or 4/3 molar sodium iodide solution and retained by occluding the ureter for one and one-half hours gives no test for iodide at the end of that time. Intravenously 25 per cent sodium iodide and sodium bromide produces no toxic effect. Potassium iodide and potassium bromide given intravenously are very toxic. Sodium bromide is more irritating to mucous membranes than either sodium iodide or thorium. This can easily be determined by placing a drop of the solution on one's tongue. Cameron also has called attention to the fact that 13.5 per cent solution of sodium iodide is as opaque as 3 molar 25 per cent sodium bromide and definitely more opaque than the standard neutral thorium solution which is correctly designated as a 5/16 molar thorium nitrate solution commonly called the 15 per cent solution. Kidney function as determined by blood chemical tests and phenolsulphonephthalein tests both in dog and man is not changed by the introduction of molar and 4/3 molar solutions of sodium iodide in kidney pelvis even when kept distended for twenty-five minutes. The same results were obtained with the 3 molar sodium bromide.

Sodium iodide has a lower viscosity than sodium bromide or thorium. Distilled water is 28, sodium iodide 29, sodium bromide 31.5 and thorium 50. This low viscosity is important as it allows great penetration.

Osmotic pressure of average concentrated urine, of molar sodium iodide, the 3 molar sodium bromide and the standard thorium solution is represented by figures 2.7, 3.78, 13.47 and 5.52, respectively. Sodium iodide is thus the least hypertonic of the three mediums, and hence the least harmful because it is well known that other things being constant, the injury produced by hypertonic solutions on living tissues increases with the hypertonicity.

In January, 1920, sodium iodide was introduced into the urological department of the New York Hospital at the suggestion of Dr. Charles Goeller, then a member of the staff. The strength of the solution first used was 13.5 per cent and later this was increased to 20 per cent which has been constantly used since that time.

Cameron noticed no serious general reaction after the use of sodium iodide. Our own clinical cases bear out this observation. Practically all cases upon whom a pyelogram is done suffer some discomfort due to the dilatation of the pelvis and ureter. This usually lasts only a few minutes but there may be a persistant ache for a longer period.

Almost any elevation of temperature can be ascribed to the dilatation of irritated tissues as it is believed that sodium iodide is practically non-irritating. In our series of over 500 pyelograms we have only had 9 cases of elevation of temperature over 100°.

INDICATIONS FOR PYELOGRAPHY

Infections of the kidney pelvis vary in intensity and destructiveness to a great extent. It is impossible to tell how much of the pelvis is damaged from the appearance of the catheterized specimen from that side. Recently a case at the New York Hospital showed at least one third of the urine collected from the right side to be composed of pus. It was supposed that there was an extreme infection of the kidney in spite of the fact that the pyelogram of the pelvis was only slightly distorted. Operation was decided upon and exploration revealed an inflammatory process that was very pronounced in the ureter right up to the kidney pelvis where it stopped abruptly.

In pyelitis we usually find a greater or less dilatation of the kidney pelvis. The sharpness of its outline is varied by having the delicate branching calyces distorted in such a manner that they look as if they had been ironed out or smoothed off. Normally these calcyes appear like flowers—the centers being formed by the papillae.

In pyonephrosis the distortion noted above is more marked and upon occasion the entire inside of the kidney may be excavated by the disease. With pus in the urine from a catheterized kidney the only possible way to determine the extent of the lesion is by pyelography.

X-ray sometimes does and sometimes does not reveal the presence of stones in the kidney.

A large stone which does not cast a shadow in the radiogram will show a thinning out of the shadow of the pyelogram at that point. If a shadow occurs in the kidney region a pyelogram will demonstrate its exact position in relation to the pelvis and therefore may be of great assistance in determining whether operation is necessary or desirable.

Hydronephrosis may be diagnosed by the presence of a steady flow of a large amount of urine through the catheter after the obstruction which causes it has been passed. This is not nearly so definite a diagnosis however as a pyelogram which shows the size and position of the enlarged kidney, as well as the extent of the destruction and usually the lesion which has caused the condition.

Malignant growths of the kidney manifest their presence early by bleeding from the ureter on that side. A pyelogram is always done in cases of unilateral bleeding because encroachment on the kidney pelvis is early and may be detected easily by a distortion or so called "filling defect" of the pyelographic shadow. To one experienced in interpreting pyelograms diagnosis may be made of very small tumors or even small malignant ulcerations of the kidney pelvis. By such early diagnosis followed by nephrectomy many lives may be saved from the horrors of cancer in its later stages.

Renal malformation such as horseshoe kidney, unilateral kidney, infantile kidney, double kidney and various other anomalies are easily detected by pyelography and by no other method is it possible to make a positive diagnosis.

Dilatation of the ureter occurs in every case of pathology of the ureter. Hunner of Baltimore has at last convinced the urologists, at least, that stricture of the ureter is not an uncommon finding in women. Our own experience at the New York Hospital has led us to believe that the condition occurs very frequently in men also. Hunner believes the etiological factor to be a focal infection such as tonsilitis or some similar chronic inflammatory lesion.

The commonest symptom of stricture of the ureter is frequency of urination. The patient seldom has pain in the flank or along the course of the ureter. The urine usually shows no pus or abnormal elements upon bacteriological, microscopic or chemical examination. Hunner is able to make a diagnosis by the obstruction to catheterization and the so-called ureteral hang which means that upon withdrawal of the catheter it is grasped by the stricture and held quite firmly as is the bougie in case of urethral stricture. By the method of pyelography which we have developed, stricture of the ureter is beautifully and positively demonstrated. Congenital stricture of the ureter while most common at its orifice may occur in any portion. When this lesion occurs at its orifice the ureter dilates and protrudes into the bladder, forming an ureterocele beautifully demonstrated in the ureterogram.

In our series we have 7 cases of double kidney pelvis, one of which is bilateral. In all but one of these cases the ureters fuse before entering the bladder presenting the usual number of ureteral orifices opening into that viscus. In practically every case of anomaly of the urinary apparatus one finds some pathological lesion present, usually it is an infection which has attacked one portion of the anatomy and left the other normal.

The principal contraindication to the use of pyelography as a method of diagnosis is the existance of a fever or a known subacute infection. It is well known that distention of inflamed surfaces is liable to cause an exacerbation of the condition. If a patient has a great deficiency of both kidneys it is unwise to subject him to a pyelogram. If he has some deficiency of both kidneys it is well to pyelograph the kidneys one at a time at separate sittings.

Any person who is aged, emaciated or temporarily in a weakened condition should not be subjected to this fairly rigorous procedure.

The method of doing a pyelography is as follows:

The patient is cystoscoped and ureters catheterized with lead catheters in the usual manner. Specimens are collected and sent to the laboratory to be examined bacteriologically (culture) chemically and microscopically. A phenolsulphonephthalein test is then performed to determine the efficiency of each kidney before the pyelogram is done. Two radiograms are taken before the injection of the opaque material, one of the kidneys and upper ureters and another of the bladder and lower ureter.

Twenty per cent sodium iodide is then carefully injected with a special syringe used for the purpose and as soon as the patient complains of a feeling of fullness some of the solution is allowed to run out and he is radiographed as above.

A fifth radiogram is taken with the patient in the erect position as suggested in 1912 by O. S. Fowler, the catheters having been withdrawn to the ureteral orifices and sodium iodide injected during this withdrawal.

We have found that many strictures and other ureteral defects are brought out in this way which are not discernible in the prone position and with the ureteral catheters in place. The sodium iodide is usually drained off by reinserting the catheters thus relieving instantly the pressure exerted by the injection.

It was formerly our practice to do a pyelogram on only one kidney at a time but since we have been using sodium iodide we unhesitatingly do bilateral pyelograms.

Sodium bromide and sodium iodide are both tolerated poorly by the bladder in some instances. For cystograms silver iodide emulsion seems to be a satisfactory medium.

CONCLUSIONS

1. Sodium iodide 20 per cent is more satisfactory as a pyelographic medium than any of the solutions used.
   a. It casts a deeper shadow.
   b. It is non-toxic.
   c. It is non-irritating.
   d. It is easily prepared.
2. Pyelography should be done only on selected cases. Persons suffering from acute or subacute infections of the kidneys, those who are emaciated or in a weakened condition should not be subjected to this examination.
3. The introduction of the solution should be carefully done. When the patient complains of a sense of pressure in the loin a few drops should be released in order to avoid distention of the kidney pelvis as experiments on animals have shown distention to cause definite damage to the renal tissue.
4. The practice of placing the patient in a sitting posture and withdrawing the catheter as the sodium iodide is injected and then immediately taking a radiogram brings out many lesions of the ureters which would otherwise not be demonstrated.

REFERENCES

Bibliography—Pyelography

CAMERON, D. F.: Aqueous solutions of potassium and sodium iodide as opaque mediums in roentgenography. Jour. Amer. Med. Assoc., lxx, 754, March 16, 1918.

VOELCHER AND LICHTENBERG: Pyelographie (Roentgenographie des Nierenbeckens nach Kollargolfüllung). München. Med. Wohnschr., liii, 105, 1906.

BURNS AND HOPKINS: A comparative study of the effects of thorium and other substances on renal parenchyma when retained. Jour. Urol., ii, 145, 1918.

Kelly and Lewis: Silver iodide emulsion—A new medium for skiagraphy of the urinary tract. Surg. Gynec. and Obst. xvi, 707, 1913.

Burns, J. E.: Thorium, a new agent in pyelography. Jour. Amer. Med. Assoc., lxiv, 2126, June 26, 1915.

Sollmann and Brown: Pharmacologic investigations of thorium. Amer. Jour. Physiol., xviii, 426, 1907.

Weld, E. H.: Use of sodium bromide in roentgenography. Jour. Amer. Med. Assoc., lxxi, 1111, October 5, 1918.

Joseph, E.: Contrast mediums for pyelography. Zentralblat f. Chir., xlviii, 707, May 21, 1921.

Merrit, E. L.: Use of sodium bromide solution in pyelography and its toxicity in comparison with other media. Boston Med. and Surg. Jour., clxxxv, 65, July 14, 1921.

Cameron, D. F.: Use of iodide in pyelography. Jour. Amer. Med. Assoc., lxxii, 1737, June 14, 1919.

Rydgaard, F.: Present status of pyelography. Hospitals tid., lxi, 937, July 10, 1918.

Emerson, C.: Pyelography, Indications and Technique, Nebraska, N. J., E. 377, December, 1918.

Burns, J. E.: Thorium in pyelography, further observations opr. use of. Jour. Amer. Med. Assoc., lxviii, 533, February 17, 1917.

Braasch and Maun: Pyelography, media employed in, effects of retention in kidney. Amer. Jour. Med. Sc., clii, 336, September, 1916.

Skurol-McConnell: New bismuth medium for pyelography. Dublin Jour. Med. Sc., cxli, 166, March, 1916.

Granger: Oxygen in cystography and pyelography. American J. Roentgenol., iii, 351, July, 1916.

Burns: Thorium new agent for pyelography. Bull. Johns Hopkins Hosp. 27; 157, June, 1916.

Eisendrath, Daniel: Jour. Amer. Med. Assoc., January 9, 1915.

PERIRENAL INSUFFLATION OF OXYGEN[1]

WM. C. QUINBY

Boston

Received for publication August 4, 1922

As a result of the continued search for methods of diagnosis accessory to the roentgenogram, the last year or two has seen the development of the injection of gas; first into the peritoneal cavity, and later into the loose areolar tissue about the kidney, in order to produce by this means a contrast in densities, and thus throw into outline organs often distinguishable but vaguely in the ordinary X-ray plate.

The use of the gaseous infiltration of the perirenal tissues was first suggested in the publication of Carelli and Sordella (1) in the spring of 1921. Since this there have been four further notes on the subject; one from Germany (2), two from France (3) (4), one from England (5). The most reliable of these are not very enthusiastic about the procedure, mostly because of certain difficulties in technique.

For something over a year since the development of the Bucky Diaphragm I have been attempting to demonstrate the detail of the injected renal pelvis in all its finer divisions by the use of stereoscopic pyelograms in which each individual minor calyx can be clearly inspected. It then seemed worth while to determine if even these really excellent results might not be still further enhanced by the use of the perirenal insufflation of gas.

METHOD OF INJECTION

Oxygen is collected in a sterile liter flask connected by rubber tubing both with another flask twice this size containing sterile water, and with an ordinary lumbar puncture needle marked in centimeters. With the patient lying on the side, after local anesthesia, the needle is introduced into the loin, pointing upward and inward toward the lower pole of the kidney. The distance to which the needle must penetrate varies greatly in different individuals, the extremes being from four to ten centimeters. The tip should go just outside the erector spinæ group of muscles, traversing the intrinsic muscles of the abdominal wall very near their origin. In order that the injection may be successful the needle tip must also pass through the fascia renalis into the true perirenal fat. If it remains outside this fascia in the

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[1] From the Urological Clinic of the Peter Bent Brigham Hospital. Read before the American Urological Association, Atlantic City, New Jersey, April, 1922.

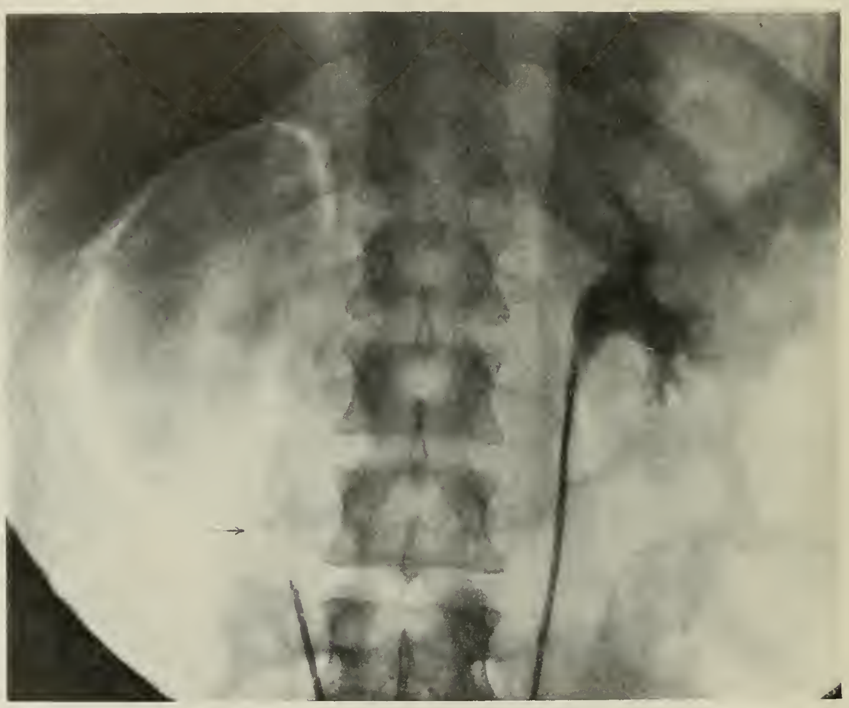

Fig. 1. Blocked Kidney in Which it Was Impossible to Inject Pyelographic Medium Because of Calculus in Ureter

Kidney surrounded by oxygen. Note normal pyelogram of other side. Arrow points to stone.

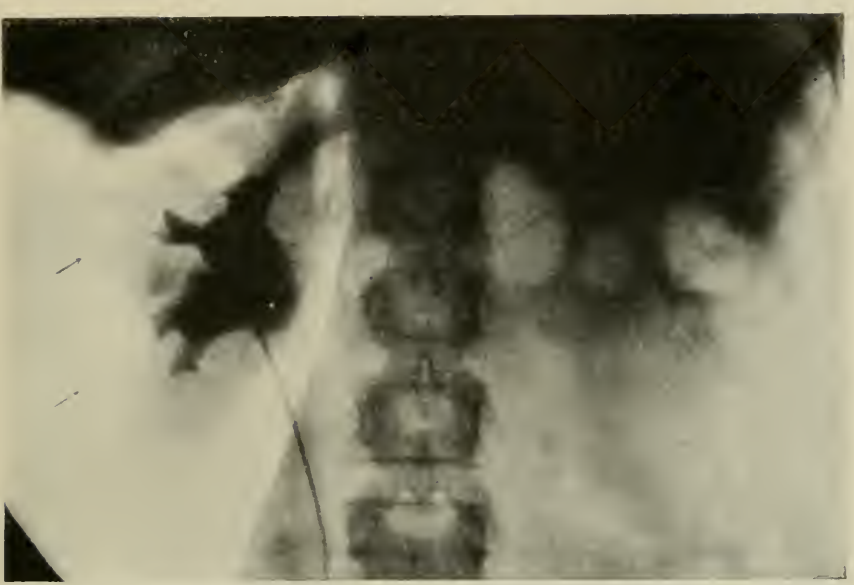

FIG. 2. RENAL FOSSA FILLED WITH OXYGEN IN A CASE OF TUBERCULOSIS OF THE KIDNEY SHOWING PERIRENAL ADHESIONS

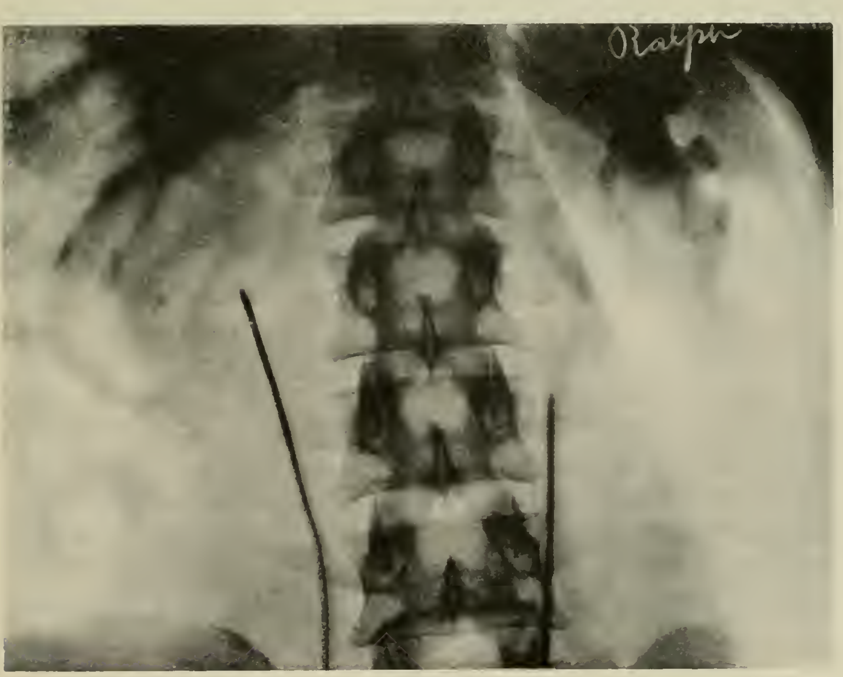

FIG. 3. PERIRENAL INSUFFLATION OF OXYGEN SHOWING LARGE ACCUMULATION OF GAS PARTIALLY OBLITERATING LOWER POLE OF KIDNEY

retroperitoneal fat layer the kidney will not be outlined. Furthermore the needle tip must not penetrate the kidney itself. It is in regard to this precise position which must be obtained that most of the negative results have been due, because the amount of perirenal fat tissue varies greatly in different individuals and in different conditions of the kidney.

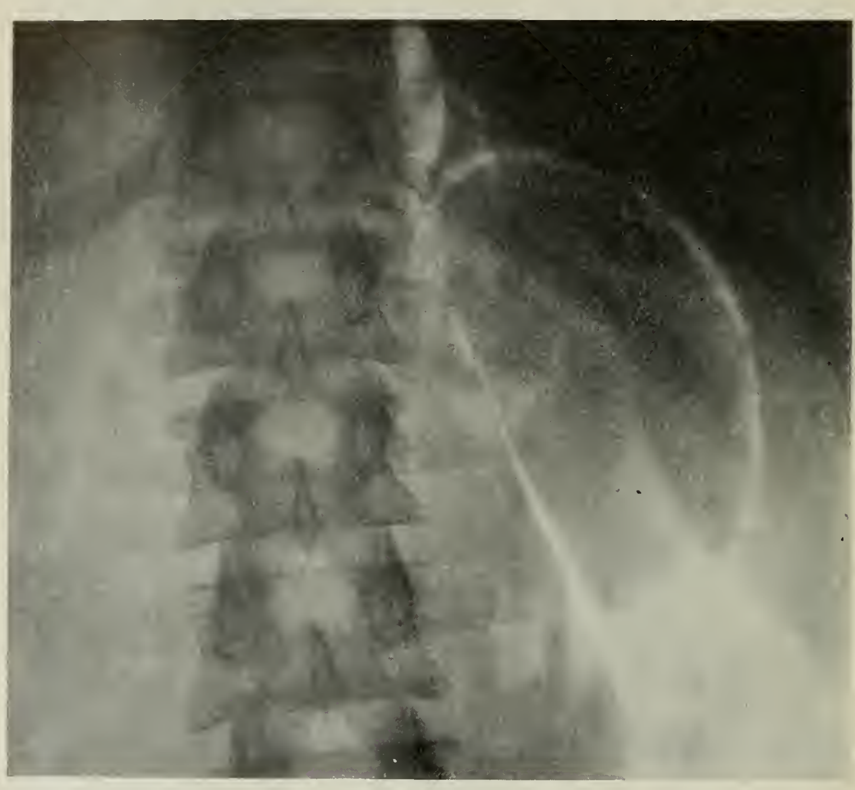

Fig. 4. Same Patient, Plate Made Twelve Hours After Previous One, Showing Better Dispersion of Gas and More Definite Outline of Kidney

The needle being placed in position, the larger of the two flasks is inverted and elevated, and thus the water flowing into the oxygen filled flask displaces the gas outward through the needle. When the needle is properly placed the inflow of gas is obtained with only moderate pressure. If the flask containing water has to be elevated more than a couple of feet above the level of the gas containing flask the needle is not properly placed and should be immediately readjusted. Injection is stopped after about 500 cc. of oxygen have been dislpaced by water.

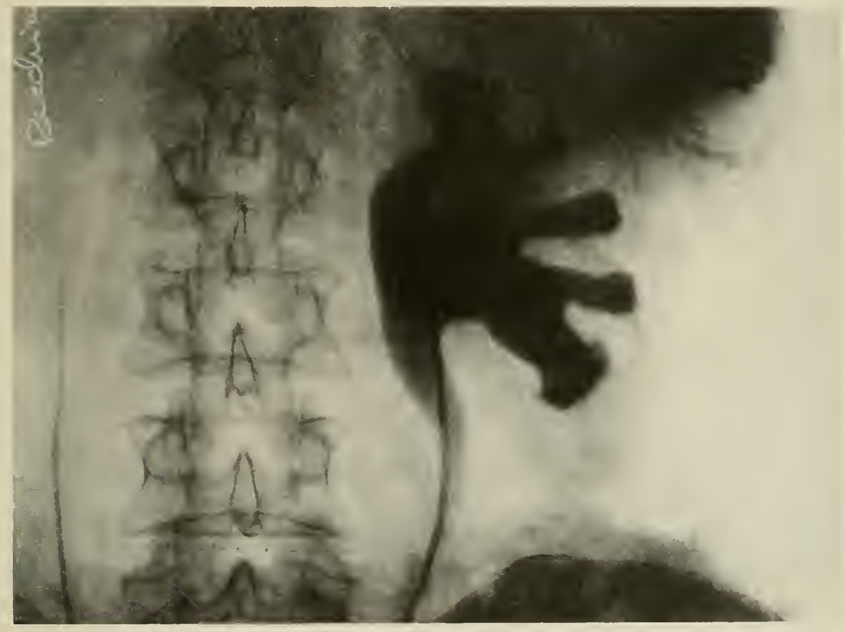

FIG. 5. PYELOGRAM OF KIDNEY WITHOUT THE INJECTION OF GAS

For comparison. Kidney shows pyo-hydronephrosis due to blocking of lower ureter by stone.

If oxygen is the gas which is used the best results are obtained by making the X-ray exposure and injection of the kidney pelvis about twelve or fourteen hours later. This is due to the fact that oxygen is absorbed from these tissues with relative slowness and by waiting this length of time the gas is given opportunity to diffuse evenly throughout the perirenal area. We frequently found that in those X-ray plates made immediately after injection the gas was so densely located about the region of the lower pole of the organ that the kidney shadow here was either much deformed or even quite invisible. This condition may not occur if carbon dioxide is used because of its greater diffusibility and quicker absorption, but I have not cared to use this gas in such quantities as are here necessary thinking that it might be more dangerous.

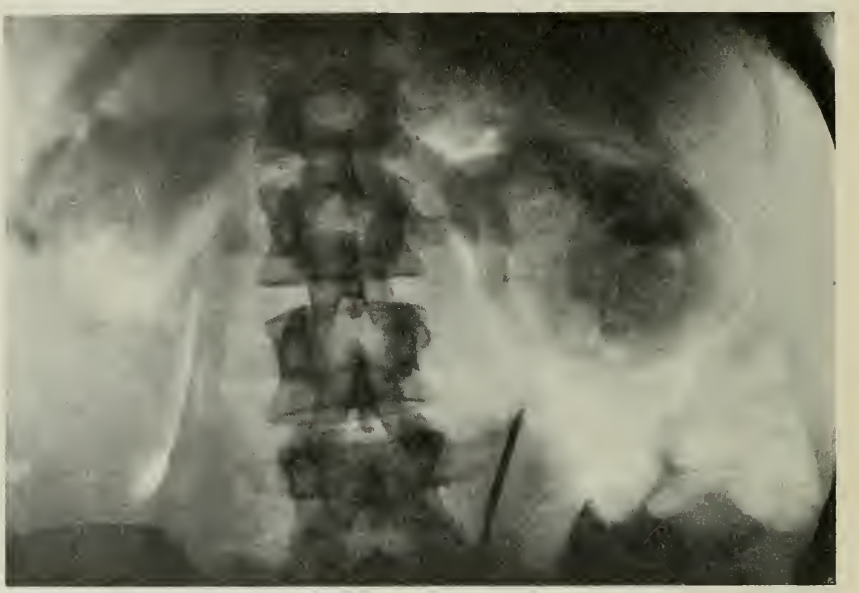

Fig. 6. Result after Filling the Renal Fossa with Gas in Case of Dense Perirenal Adhesions Described in the Text

Note great indefiniteness and irregularity of resulting X-ray plate

RESULTS

Except in one case we have had no untoward results from the perirenal injection of oxygen, either immediate or remote. The patient usually experiences on injection a sense of fullness in the loin which generally is of so slight degree as not to constitute pain. If pain is caused this is usually but temporary. In the instance referred to of immediately unfavorable sequelæ the patient showed pallor, sweating, faintness, labored breathing, and a slight cough, all of which symptoms disappeared in about thirty minutes. The picture here presented was quite like that following a blow on the solar plexus plus irritation of the diaphragm. There had been two previous surgical explorations of the kidney at the hands of other surgeons, sufficient, of course to produce dense adhesions about the organ, and my explanation of these above untoward symptoms is that they were due to sudden tension on the important sympathetic ganglia around the coeliac axis. I feel, therefore, that the knowledge of the existence of dense adhesions about the kidney, such as follow previous operation, forms a definite contraindication to the insufflation of gas.

With this exception, therefore, we have seen no trouble follow the injection. It is hard to see how such occurrences as mediastinal emphysema or penetration of the bowel, as reported in the note of Chevassu and Maingot, can follow if the person introducing the needle has any reasonable powers of visualization and knowledge of anatomy.

X-RAY RESULTS

Does the injection of gas about the kidney tell us anything which we cannot learn by other and simpler methods? With proper X-ray technic and the use of the stereoscopic plates made over the Bucky Diaphragm it is possible to obtain pyelograms which are very conclusive. Our experience is that in the usual case the presence of gas about the kidney does not give plates of any greater value. In the occasional case, however, where the patient is large and fat, or in those instances where the ureter is blocked by stone, or where for any other reason it is found impossible to inject the kidney pelvis at all, a knowledge of the kidney outline made possible by the injection of gas is often of distinct value.

I consider, therefore: First, that the method is of no danger in properly selected cases; second, that the technic of its production is relatively easy; third, that in certain instances it may be of definite aid in arriving at a diagnosis in properly selected cases, but fourth, that in the majority of cases stereoscopic pyelograms well made will give all the information necessary or obtainable by the further injection of gas.

REFERENCES

(1) Carelli, H. H., Sordella, E.: Un nuevo procedimiento para explorar el riñon. Rev. de l'Asociación Med. Argentina, 1921, xxxiv, 424.

(2) Rosenstein, L.: Zeit. f. Urol., 1921, xv, 448–458.

(3) Chevassu et Maingot: A propos de l'insufflation périrénale. Journal d'Urologie, 1922, xiii, 54–57.

(4) Chevassu et Maingot: L'inconstance des résultats fournis par l'insufflation périrénale. Journal d'Urologie, 1922, xiii, 118–125.

(5) Hernaman-Johnson: The Carelli Method of Perirenal Inflation. Brit. Med. Jour., January 21, 1922, 91–92.

DISCUSSION

Dr. H. R. Muller, New York: Dr. Lowsley has asked me to say a word concerning the results of his experimental work of injecting solutions under pressure into the pelvis of the kidney of rabbits. The substances used were solutions of potassium iodide, sodium iodide, sodium bromide, ammonium bromide, potassium citrate, iron pyrophosphate, collargol and thorium.

All together 16 kidneys were injected, and, excluding the condition of "cloudy swelling," the following histological changes were observed in 10.

In 4 kidneys, that is, 2 injected with potassium iodide and in 2 injected with iron pyrophosphate, there was seen a complete necrosis of all the structures of the kidney, including tubules, glomeruli and interstitial tissue. Such a change was probably not caused by any toxic action of the solution used, but rather to an interference with the blood supply to the kidney. It is really an infarct of the kidney. As probably causes, the pressure of the distended pelvis on the renal vessels must be considered, and also, whether or not during the operation the artery was injured and became thrombosed.

In 1 case where sodium iodide was used and once each with iron pyrophosphate and with thorium, necrosis limited to the epithelium of the convoluted tubules was observed. Here it looks as if there had been a toxic action of the solution on a specific part of the kidney.

The other changes were glomerulitis in 1 instance where sodium bromide was used; chronis pyelitis, with sodium bromide; and subacute interstitial inflammation of the medulla seen once with collargol. These lesions were so few in number that their significance awaits further investigation.

Finally, "cloudy swelling" was such a common change, and was seen so often in the control kidneys as well as in the injected kidneys that did not present any of the above mentioned lesions, that its significance should be interpreted with caution. Besides the personal element enters into its recognition and interpretation to so large an extent that one must be careful in attaching too much significance to it.

The total number of experiments is small and it is planned to continue these experiments on a larger scale. These observations must, therefore, be considered as entirely preliminary.

Dr. W. F. **Braasch**, Rochester, Minn.: Doctor Lowsley is to be congratulated on his excellent pyelograms. There is not much choice between sodium iodide and sodium bromide as a medium for pyelography. We used iodide for a long time but owing to the fact that it gave no denser shadow, and that it occasionally seemed to cause more local irritation, we finally returned to sodium bromide and have continued its use for the past year. For economic reasons and because of it occasional toxicity thorium is not generally employed.

Dr. Mann and I have shown experimentally that there is little difference in the effect on the kidney of sodium iodide and sodium bromide when injected into the renal pelvis. However, the ideal medium for pyelography has not yet been attained. Neither iodide nor bromide will cause much irritation unless it is retained in the renal pelvis. But when unable to drain from the pelvis either medium will occasionally cause cortical abscesses and acute nephritis. When clinical evidence of such cortical infection is present the pelvis should either be drained by a ureteral catheter or the kidney must be removed without delay. Unfortunately, neither iodide nor bromide will outline the ureter satisfactorily. Colloidal silver did that much better than either, but it should, of course, not be used.

Dr. Rowntree has recently demonstrated that when a large amount of sodium iodide is introduced into the system it will be excreted by the kidneys in amounts sufficient to cast a shadow in the roentgenogram. It is well known that the human body will tolerate large dosage of saturated solution of sodium iodide injected intravenously, as shown in the treatment of syphilis. It is astonishing how clearly the urinary tract, and particularly the bladder, is outlined in the urogram following the intravenous injection of from 100 to 200 cc. of sodium iodide. The outline of the renal pelvis and the ureter has not proved satisfactory with the present development of the technic, but it is hoped that this will be improved in the future. Moreover, the patient will sometimes have a marked reaction following the administration of such large doses of iodide, and it should be used with caution. The outline of the bladder is quite clear about two or three hours after the injection of iodide. Dr. Rowntree is about to publish his data.

Dr. I. L. OHLMAN, Pittsburgh, Pa.: Irrespective of what solution is used, I wish to say that I am unalterably opposed to bilateral pyelograms at the same sitting. Given a pair of kidneys that are just equal to carrying on life under ordinary conditions, do a double pyelography and sufficient irritation or reaction may be produced to lead to a fatal result. Occasionally through error even when the practice is to make unilateral pyelograms the pyelogram will be made of the healthy kidney the kidney that is maintaining life, and a very stormy time ensues. You may have symptoms or findings presented that lead you to believe that the right kidney is diseased, whereas it is the opposite kidney that is not normal. You do a pyelogram on the good kidney and because of decreasing its functional capacity you then bring the functional capacity of the two kidneys, as a whole, below that at which life can be maintained. I realize that it increases the work of the surgeon considerably to do pyelography at two different sittings, but I believe it is a far safer procedure.

Whether or not my bump of caution is greater than most men I do not know, but I believe I will occasionally escape a death, whereas a man doing a double pyelography will have a fatality.

Dr. HAMILTON W. McKAY, Charlotte, N. C.: We have been very much interested in the effect of different solutions used in pyelography, and we believe we have found two definite disturbances in the kidney as a result of the use of sodium bromide; namely, small discrete hemorrhages in the mucosa and temporary reduction of the kidney's functional activity. We feel that this is due to one of two things: The question of hypertonicity of the sodium bromide solution or to the excessive pressure used when injecting the kidney.

One reason I wanted to say a work on this subiect was to present a photograph of a little device which one of my associates, Dr. L. C. Todd, has arranged to measure the pressure in doing pyelograms. If this little device appeals to you at all I am satisfied that it is because of its simplicity and the fact that it is a "one man" device (exhibiting device).

Dr. Granville MacGowan, Los Angeles: Some of us did not understand Dr. Braasch's statement in regard to the use of iodide of sodium intravenously and as a question of privilege I ask that you request him to repeat it. The amount of iodide given intravenously appeared to be extremely large, and we are not sure whether he meant to say iodide of sodium used in large quantities intravenously, or in large quantities intravesically. We give iodide of sodium by intravenous injections in doses of 30 cc. of a 10 per cent solution, but in greater quantities than that I, for one, have never heard of its being used intravenously.

Dr. Clarence G. Bandler, New York: A point in technic, that Dr. Lowsley brought out, which we consider rather dangerous is injecting the pelvis of the kidney until the patient complains of distention. For a number of years in our work we have colored the pyelographic solutions with methylene blue; thus we can note the appearance of the material along side of the catheter, at the ureteral orifice, and avoid over distention of the renal pelvis. We also prefer the gravity method of introduction instead of the syringe method utilized by Dr. Lowsley, and we have been employing, for a year, 25 per cent bismuth and ammonium citrate solution. We have had no untoward results and have used it in at least 100 cases.

Dr. Quinby's presentation of the perirenal insufflation method is worthy of comment. Any of you who saw the films of Dr. Carelli probably observed the best X-ray pictures that have ever been seen. I saw the suprarenal glands very distinctly shown in a number of instances. I think that carbon dioxide, possibly, is better for this work than oxygen, for carbon dioxide is very readily eliminated by the body. If you take a picture within half an hour after the injection you get an excellent outline of the kidneys.

I would also like to mention one case in which I do not know of any other method, than this perirenal insufflation, that would have been of value, a tumor of the kidney on the convex border. The cystoscope showed no evidence of disease and the pyelogram was negative, but with perirenal insufflation we were able to outline, very definitely, the tumor on the convex border of the kidney.

Dr. Edward L. Keyes, Jr., New York: I would like to vote with those who are fearful of double pyelography. Last winter we cystoscoped a patient who had been cystoscoped before without mishap. We put two catheters up his ureters and even without injection he had anuria, almost complete, for twenty-four hours. A single pyelogram adds to the dangers of cystoscopy and a double more than doubles the danger. It is surely safer to use the gravity method; one can judge of the fulness of the renal pelvis by watching the fluid descend in the little tube in which it is held. It will descend at an even rate until the pelvis fills, then stop an instant. Then go on again and the patient will then complain of pain. One should take the pyelogram when the stoppage does occur.

I am interested in the Carelli method of injecting air and agree fully with all the cautions that Dr. Quinby has reported. I have used this method at Bellevue and have had but one accident, that in a case in which I myself wielded the needle. I stuck a needle into the back and injected oxygen. The patient was rather benefitted because he got an acute suppurating nephritis which caused him to be operated upon twenty-four hours later, when we discovered a tuberculous kidney.

Two deaths have been reported due to Carelli injections and no doubt there will be more if we continue, but in rare cases we may get a diagnosis by injection of air that we could not get in any other way.

Dr. O. S. Lowsley, New York (closing): I appreciate the words of caution that have been expressed and agree with them thoroughly. Pyelography should be done only on selected cases. I think the number of selected cases should be very greatly increased because there are certain conditions which it seems to me are almost impossible to detect without pyelography. Therefore, I think pyelography, due to its previous reputation when we were using toxic chemicals, got into such disrepute that we have not been doing enough in an effort to properly diagnose obscure cases.

It is most interesting indeed to hear Dr. Braasch refer to Dr. Rowntree's recent experiments and I am sure we will all be glad to have him tell us the details as to dosage and so on.

I quite agree that the ideal solution has not been found and that is what prompted this research—to find something that would be more ideal than the ones we have. One word of caution about using sodium iodide or bromide in the bladder—if an infected bladder is distended with either of these preparations we have a considerable amount of irritation, which may be quite serious in some cases. We use various other things for taking cystograms. We unhesitatingly do a bilateral pyelography on selected cases. Where the patient is aged or infirm, or has a fever, or a known infection, we do not do any pyelograms. We believe those conditions should be overcome insofar as possible. It is an emergency, if we do a pyelogram on a patient aged or infirm, we do it on one side first and then two or three weeks later, on the other side. In properly selected cases we have had no accidents except the one I showed you. We utilize the methylene blue method where we think it necessary, where it is important not to distend the kidney pelvis at all. Those cases can be selected beforehand.

Regarding the perinephritic injection of air that Dr. Quinby spoke of, we have resorted to that on several occasions in which it was impossible to catheterize the ureter and we were greatly helped by the shadow of the kidney we obtained. A friend of mine recently returned from Europe and presented me with copies of a great number of slides which Rosenstein has taken in Berlin, and they are very beautiful pictures.

Dr. W. F. Braasch, Rochester, Minn. (replying to Dr. MacGowan): The method employed by Dr. Rowntree is to inject 100 to 150 cc. of sodium iodide intravenously. The urogram is made two hours following injection. The intravenous injection of huge doses of iodides has been previously employed by various authorities in the treatment of syphilis. The initial dose is usually moderate, and it is rapidly increased as the patient becomes accustomed to the drug. We are not certain how great the practical value of the method may be, but Dr. Rowntree's suggestion is certainly very interesting.

PYELONEPHRITIS[1]

WILLIAM C. STIRLING, JR.

Urologist Lawrence Clinic, Winston-Salem, North Carolina

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During the past year 80 cases of pyelonephritis were seen and treated at the Lawrence Clinic and it is on this series that the following observations have been made. Surgical conditions of the urinary tract such as tumors, malignancy and calculi have been omitted.

This paper deals with infections of the kidney pelvis by microorganisms other than the tubercle bacillus.

In the study of these cases as well as the literature on this subject one is forcibly impressed with the following conclusions:

1. That this condition is being constantly overlooked by the internist as well as the general surgeon.
2. That patients are being operated on for many intraabdominal conditions such as appendicitis, cholecystitis and pelvic inflammatory disease without a complete microscopic urinalysis being made.
3. The onset being insidious and the physician not recognizing the condition, the kidney or kidneys are seriously involved, before the true condition is detected.
4. Many operations are performed, needlessly, on so-called acute surgical kidneys, which in many instances would respond to pelvic lavage.

In an analysis of 1000 autopsies in a hospital center in the army, definite inflammation of the kidney pelvis was found in 20 per cent of the cases, which had not been recognized before death. This is conclusive proof of the frequency of this condition as well as its lack of recognition.

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[1] Read at the meeting of the American Urological Association, Atlantic City, New Jersey, April, 1922.

CLASSIFICATION

This series is divided into the following groups:

1. Pyelonephritis of childhood.
2. Pyelonephritis of pregnancy.
3. Pyelonephritis following operations.
4. Pyelonephritis resulting from foci located elsewhere in the body.

In the first group 3 cases were seen, 5 cases of pyelonephritis of pregnancy were seen. Ten cases of pyelonephritis following operations were observed while 62 cases were seen as a result of foci of infection located elsewhere in the body.

AGE

From 10 to 20 years	6
From 20 to 30 years	17
From 30 to 40 years	27
From 40 to 50 years	15
From 50 to 60 years	8
From 60 to 70 years	3
From 70 to 80 years	4

BACTERIOLOGY

It has been the consensus of opinion that kidney infections were due, in a vast majority of the cases to the Gram-negative group of bacteria known as the bacillus coli communis. Due, doubtless to the fact that this group of organisms are usually found in the urine in these cases. Bumpus, Meisser, Rosenow, LeFur and others, in their work on focal infections have proved this view to be erroneous. Rosenow in his work on the selective action of the streptococci, paved the way for the now firmly estalished modern conception of these infections. Recently Bumpus and Meisser have proven that certain strains of the green producing streptococci have a selective action on the kidney. They have also shown that certain strains of streptococci have a selective action on the urinary bladder. LeFur by a series of intravenous injections of colon bacilli has shown that these organisms do not have any such selective action on the urinary tract, and that they are secondary invaders. Dick in a study of 25 cases of renal infection, was able to isolate the streptococci in 15 cases. He also contended that nephritis could be caused by bacteria. Emerson is of the opinion that focal infections play an important part in nephritis. Rosenow has recently shown there is a close relationship between renal calculi and streptococci isolated from patients suffering from nephrolithiasis. Hugh Cabot calls attention to the fact that cocci have a predilection for the cortical areas of the kidney, while the colon bacillus is associated with pelvic inflammations. In many cases it is difficult to demonstrate the streptococcus in the urine in these infections, because the colon bacillus grows much faster than the streptococcus, and literally crowds them out. If careful search is made the streptococcus can usually be found in the specimen. In this series, the urine was carefully collected under aseptic conditions, centrifuged, stained and examined for the infecting organism. The colon bacillus was seen in 75 per cent of the cases. Guinea-pig inoculations were made where tuberculosis was suspected. Seventy per cent of this series showed bilateral involvement of the kidneys, 20 per cent were on the right side while only 10 per cent were infections of the left side.

Embryologically, the kidney has a double origin; the filtering portion of the kidney being derived from the mesothelium, and it is this portion of the kidney that coccus infections are so commonly seen. The collecting portion of the kidney comprising the ureter, pelvis, calices and straight collecting tubules are developed from the Wolffian duct, and are concerned in colon bacillus infections. It is in this latter type of infection that pus is so freely demonstrable in the urine. In this series there were 36 males and 43 females.

OTHER ETIOLOGICAL FACTORS

Many contributing factors must be considered in treating and eliminating the cause of pyelonephritis. In this series 5 cases had definite lesions of the prostate and seminal vesicles which cleared up after proper treatment of these foci. Intestinal foci doubtless play an important part in certain of these infections. Definite lymphatic connection between the colon and kidney as well as the pelvic organs and kidney has been demonstrated. Many authors advocating colonic irrigations in infants with pyelonephritis. Four cases were seen associated with pelvic inflammatory disease. Hunner is of the opinion that ureteral stricture with subsequent lack of drainage is responsible for a large number of renal infections. Certain it is that the kidney like any other excretory organ must have drainage and such conditions as pregnancy, nephroptosis, new growths, peritoneal adhesions, prostatic hypertrohy, defects of posture play an important part in infections of the kidney. The frequency with which pyelonephritis is seen following operations for septic conditions is doubtless due to the infection traveling by the blood stream. McNider has shown there is a definite lowering of the kidney function following the use of a general anesthetic, with a disturbance of the acid-base equilibrium. Forty-three per cent of the series had been operated on in other hospitals for surgical conditions other than the urinary tract, without relief of the symptoms but after careful elimination of the kidney infection the results were very gratifying.

Pathology

In the cases of so-called pyelitis there is an accompanying nephritis, just as there is involvement of the pelvis in nephritis, though the pelvic symptoms may predominate. The kidney is acutely inflamed, with cloudy swelling as well as round celled infiltration about the tubules and in the more virulent infections many punctate abscesses are seen distributed in the parenchyma of the kidney. They may rupture beneath the capsule and produce a perinephritic abscess or involve the pelvis with a resulting pyuria. The pavement epithelium of the pelvis is usually thickened and the pelvis may be dilated associated with distortion of the outline.

Blood examination

The blood picture in renal infections, varies, depending on the acuteness or chronicity of the condition. In many of the chronic cases the leucocyte count varied from 7000 to 9000, while in the acute infections, a marked leucocytosis was seen, ranging from 8000 to 14,000. This is a distinguishing feature between acute abdominal conditions and pyelonephritis, the former as a rule having a higher leucocyte count with a relative increase in "polys."

Symptoms

The most prominent symptom complained of was frequency of urination. Eighty per cent of the series had this symptom while 70 per cent had pain in the back, a symptom the laity commonly associates with kidney trouble. Forty per cent had dysuria and 30 per cent had burning on urination. Hematuria was complained of by 25 per cent of the cases. Ten per cent complained of nausea and vomiting. On making a vaginal examination pain was usually elicited when the ureter was palpated on the affected side.

Diagnosis

The diagnosis of pyelonephritis can usually be made from the history and physical examination together with the urinary findings. By means of the cystoscope the diagnosis can be confirmed, the presence of cystitis determined, and whether one or both kidneys are affected as well as the functional activity of the affected side. Eighty per cent of the cases showed definite involvement of the bladder, varying from a slight congestion to diffused inflammation. Injection of the pelvis with sodium bromide was a very valuable adjunct in the diagnosis of tumors, hydronephrosis, and renal tuberculosis, little reliance being placed on guinea pigs in the latter condition. Wax tipped catheters are used routinely as strictures of the ureter can be readily diagnosed by this method and an occasional stone can be found that had escaped the roentgenologist. The Kelly open cystoscope was used in females in many of the cases and an indirect instrument in males. The use of the Kelly instrument simplifies cystoscopy in female patients. Another very valuable diagnostic point was fist percussion over the suspected kidney, as this was positive in 90 per cent of the cases. Repeated search should be made for pus in the urine in suspected cases, as the urine may be free of pus at one time and contain large quantities of pus at the next examination.

Treatment

The factors concerned in the treatment of this series was divided into six groups.

1. Supportive
2. Internal medication
3. Cystoscopic
4. Surgical
5. Elimination of the foci
6. Vaccine

1. Supportive. Rest in bed was urged in all cases where feasible, as well as the ingestion of large quantities of water. A diet was prescribed free of red meats and all condiments and rich foods were omitted.

2. Internal medication. Various drugs have been recommended from time to time for the treatment of diseased kidney conditions. Among the most valuable are urotropin and salol; insuring the action of the former by rendering the urine strongly acid, with acid sodium phosphate or benzoic acid. In some cases of marked acidity, by changing the reaction of the urine, benefit was obtained. In no case was total reliance placed on this method of the treatment to the exclusion of others.

3. Cystoscopy. It was found that after eliminating the focus it was necessary to treat the pelvic inflammation. It has been shown that certain drugs have a very penetrative action and cases are shown where the injected solution has been found as high as the glomerulus of the kidney. By means of the ureteral catheter drainage could be established which was ipso facto a very potent aid in eliminating the pathology. Various drugs were used, chief reliance being placed on the action of the silver salts. Silver nitrate was used in from 1 per cent to 5 per cent. Mercurochrome was also used but many of the cases did not respond as well to this drug as to silver nitrate. In cases of hematuria, 5 per cent silver nitrate solution was used with very satisfactory results. Better results were obtained where the pelvis was slightly distended.

4. Surgical. One case required a nephrectomy to save the patient's life. On section the kidney was studied with numerous small abscesses, the capsule very adherent, the glomerulus filled with an exudate containing polymorphonuclear leucocytes, the tubules also showing both round cell and polymorphonuclear cell infiltration. The function of this kidney was *nil.* One case required a nephrotomy as the x-ray showed shadows resembling a stone in the kidney pelvis, the calices contained deposits of lime salts which had probably caused the hematuria. This case made an uneventful recovery. One other case required a nepropexy as the pyelogram showed a marked sagging of the kidney and kinking of the ureter. Many of the so-called surgical kidneys can be saved an operation by proper drainage and elimination of the focus.

5. Elimination of focus. In every case, a very careful physical examination as well as X-ray was made to determine the cause. Removal of the tonsils was advised in all cases. Allshowedpus after removal, although appearing macrosopically normal before tonsillectomy. Forty per cent of this series had abscessed teeth while thirty per cent had definite tonsil infection. This was probably low as several patients refused tonsillectomy. Other accessory factors were such condition as sagging kidney, pelvic inflammatory disease, appendicitis, cholecystitis and intestinal toxemia nose and the sinuses. Mechanical defects must be corrected and proper drainage established. The majority of the cases of pyelonephritis cleared up with rest in bed, diet, forced fluids, drainage and elimination of the cause. No deaths occurred in this series and cures were obtained in over 95 per cent of the cases treated. No case was discharged until the urine was rendered sterile to culture.

6. Vaccine. Vaccines were used in some cases with rather indifferent results; no special benefit was obtained where used alone.

SUMMARY

1. A large number of so-called surgical kidneys can be saved an operation by drainage and lavage of the kidney pelvis.

2. At least 50 per cent of the cases of pyelonephritis are being treated for other conditions such as appendicitis, cholecystitis, duodenal ulcers, etc., without the formality of an urinalysis.

3. Careful elimination of the foci as well as other accessory factors will clear up the majority of the kidney infections.

4. Repeated search should be made of the urine for pus, as one negative urinary examination does not always eliminate the urinary tract.

5. The colon bacillus usually crowds the streptococcus out, which has been demonstrated culturally, making it difficult to demonstrate it in the urine in these infections.

REFERENCES

Keyes, E. L., Jr.: Infections of the kidney. Cabot, Urology, 1918, p. 447.

Mayo, W. J.: Hematogenous infections of the kidney. Jour. Amer. Med. Assoc. 1919, 1023–1026.

Bumpus, H. C., Jr., and Meisser, J. G.: Focal infections in relation to submucous ulcer of the bladder. Jour. Urol., 1921, 285.

Rosenow, E. C., and Meisser, J. G.: Nephritis and urinary calculi after production of chronic foci of infection, preliminary report. Jour. Amer. Med. Assoc., 1922, lxxviii, 266.

Bumpus, H. C., Jr., and Meisser, J. G.: Foci of infection in cases of pyelonephritis. Study 1–1, Jour. Amer. Med. Assoc., 1921, lxxvii, 1475.

Emerson, C. P.: Acute Element in Chronic Nephropathies, 1921, lxxvii, 145.

LeFur: Des ulceration vesicales et en particulier de l'ulcere simple de la vessie, Paris, 1901, pp. 810.

McNider, W. B.: A study of the anurias in normal animals during the use of general anesthetics. Jour. Phys. Exp. Therap., 1920, xv, no. 4.

McNider, W. B.: A study of renal function and the associated disturbance in the acid base equilibrium of the blood in certain experimental and acquired nephropathies. Arch. Int. Med., 1920, xxvi, 1–37.

A PRELIMINARY REPORT OF THE GERMICIDAL CHARACTER OF EMANATIONS FROM COLLOIDS OF CERTAIN SILVER SALTS[1]

EDGAR G. BALLENGER AND OMAR F. ELDER

Atlanta, Georgia

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In two previous papers we have reported our experimental work with colloidal silver chloride as a germicide, directing attention to its high germicidal value, its emanations, and to its non-irritating qualities. Furthermore, we reported that this germicide could be given intravenously to rabbits in doses sufficiently large to sterilize the blood in twenty-four hours when the rabbits had been previously inoculated intravenously with cultures of the staphylococcus aureus.

In the present paper we desire to summarize the preliminary work so far done, which shows the harmlessness of this germicide on inflamed surfaces and that it may be given, in certain conditions, in effective doses intravenously.

For sometime we had been experimenting with germicides but it was not until we began with colloidal silver salts that our results became of interest.

The basic point we started with was that metallic silver prevented the growth of organisms immediately around it. This fact was first observed by Marion Sims in his work on vesicovaginal fistulas. It occurred to us that non-irritating salts of silver might exhibit this quality, so we began a series of tests with the colloidal preparations of silver.

The lantern slides which we will show you of agar plates of the various tests with silver wire, colloidal silver chloride, colloidal silver iodide, and other silver salts, on cultures of staphylococcus aureus demonstrate a fact which we think has not, hitherto, been observed, namely, *that colloidal silver preparations give off emanations which prevent the growth of microörganisms immediately around the sealed glass tubes containing them.*

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[1] Read at the meeting of the American Urological Association, Atlantic City, April, 1922.

The comparative harmlessness of this preparation was clearly shown by the fact that spermatozoa could live and remain actively motile in a 1 per cent solution for fifteen minutes or longer. The highly organized and delicate character of these cells naturally would show quickly the results of irritating or poisonous chemicals. Dr. John Funke, Professor of Bacteriology at Emory University, found that 5 per cent colloidal silver chloride, when diluted 400 times, killed the typhoid bacillus in two and one-half minutes, though carbolic diluted 80 times did not kill in two minutes. Our various tests showed that colloidal silver chloride had a selective action against microörganisms, probably an adsorptive affinity, and that it was not irritating to the body cells to which it was applied.

A 5 per cent solution of silver chloride diluted 3000 times, mixed with the secretion from a foul mouth in which actively motile spirochetes were observed, stopped the motility of the spirochetes in four minutes. Many subsequent tests confirmed the early encouragement and now we have employed it in 300 patients with genito-urinary affections.

We were pleased to note in a recent number of the Journal of Urology, July, 1921, an article by Ralph B. Cobb, entitled "A New Advance in Silver Therapy," who reported very satisfactory results with colloidal silver chloride as prepared by Hille, the discoverer of argyrol. His observations of its clinical application to the mucous membranes of the urologic organs are practically in accord with our own experiences.

We sealed our colloidal silver chloride, as strong as 5 and 10 per cent, in the anterior urethra, using collodion over the meatus to prevent its escape, and it was without pain to the patient when so employed for three to five hours, nor was urination painful after the collodion was removed. The mildest remedies we have been able to use in this manner, heretofore, were not without discomfort and did not have anything like the germicidal value of the colloidal silver chloride.

EMANATIONS

As previously stated, colloidal silver chloride has the faculty of giving off emanations which apparently penetrate further into mucous surfaces than the other remedies we have been able to obtain. This fact is shown by both laboratory and clinical work; the clinical tests lead us to believe that in *early* infections we are sometimes able to destroy gonococci in the glands of Litré in the roof of the urethra when the solution itself could not enter them. The mucous membrane seems to be little more difficult for the emanations to penetrate than is glass, which the photographs of the agar plates show offers slight obstruction. The clinical results, however, do not seem to be greatly improved by this fact for most of the time the organisms are protected sufficiently by pus and by the inflamed tissue to prevent the desired deep penetration of the emanations.

The reason we believe that there is sometimes adequate penetration is that we were able to cure patients with gonococcal infections by sealing colloidal silver chloride in the anterior urethra after other remedies used in the same manner had failed to effect the cure expected when there is only a surface infection.

Tests were made with cellosilk, collodion and peritoneum from the intestines of pigs; all of these allowed emanations to pass through them.

The reason that the colloidal preparation of silver gives off so much more of the emanation than the metallic silver is probably because of the enormous increase in the surface provided by the infinitely small subdivisions of the silver and the Brownian activity. It is not apparent why a 10 per cent solution of nitrate of silver should give off none or so little as not to influence the growth of bacteria on the agar plates. In the heated end of the tube, where some of the colloid was burned, there was frequently given off definitely larger amounts of the emanations than from the part where only the solution was in the tube. This puzzled us, at first, until we learned that Rutherford, in 1906, found that cocoanut charcoal absorbs radioactive emanations. The charred material in the burned ends evidently absorbs the silver emanations and then allows its escape with greater readiness than the solution.

Empty spaces or bubbles also often destroy the germs for a greater distance than does the colloid. This phenomenon is probably due to the wider play of the gaseous atoms. The Brownian movement so clearly seen with the ultramicroscope is only a visible demonstration of what is going on with infinitely smaller gaseous particles which are less obstructed by air than are the particles by the surrounding colloidal preparation.

The study of colloids, while most fascinating and intimately connected with much that goes on in and around us, is far too complicated and extensive to discuss in this connection. Many useful books have been written on colloids, their preparation and characteristics, and yet there remains much to learn about them. It is sufficient here to say that colloidal sols of metallic substances or insoluble salts consist of minutely sub-divided masses held in suspension by the Brownian movement.

CLINICAL USES

No irritating effect was noted when this preparation was given as an injection or instillation into the urethra; injected into the bladder; injected into the pelvis of the kidney for pyelitis; injected into fistulous tracts, abscess cavities; applied to the conjunctiva, mucous membrane of the nose, throat or ear, antrum of Highmore; used as a wet dressing, etc.

In spite of the high germicidal value, however, there were not many surprising results in the routine treatment of the average patient with well established gonococcal infection for the obvious reason that the medication could not be carried to the deep foci of the infection such as the prostate, etc.

When employed early and sealed in the anterior urethra, it gave us a larger percentage of prompt cures and with less discomfort than anything we have heretofore used.

Being non-irritating and white, unless exposed to strong light, makes it more pleasant to use than the preparations which leave stains.

Subcutaneously colloidal silver chloride causes about the same painful reaction that follows the subcutaneous injection of salvarsan, though immediate pain is not caused.

INTRAVENOUS INJECTIONS

Rabbits inoculated with fatal doses of the staphylococcus aureus did not die if 1 cc. of a 1 per cent colloidal silver chloride sol was given intravenously fifteen or twenty hours later. The control rabbits which received similar infections and were not treated with colloidal silver chloride died in forty-eight to seventy-two hours with multiple abscesses of the liver, kidneys, heart and other organs.

Freshly made solutions were found to have greater germicidal value than were the preparations several days or a week old.

These early tests lead us to hope that similar results could be obtained in patients, but with the small doses employed, there have not been any strikingly good or uniform results in gonococcal infections except in epididymitis and salpingitis with symptoms of peritonitis. In the latter condition some quite encouraging results were obtained though the group of patients is too small to consider the prompt relief a result which can always be counted upon.

As regards certain acute focal infections the results were much more encouraging. We think that one or two courses may be expected from intravenous injections; (1) an abscess may be aborted, or (2) it may suppurate more promptly.

Five cubic centimeters of colloidal silver chloride diluted with 20 cc. of physiologic salt solution was not fatal to rabbits when given intraperitoneally.

A series of experiments are now being made with tubercular and other infections, and in due time we will report the results. The work is being done by Dr. Klugh in the laboratory of Drs. Bunce and Landham, who made the agar plate tests.

REACTIONS

We are annoyed at times by the usual serum reactions (nitritoid crises) which follow salvarsan and such intravenous injections. They are usually insignificant though occasionally severe and may cause pain in the loins or chest. Flushing of the face is the most usual type and may be prevented by a preliminary hypodermic of 6 or 8 minims of adrenalin chloride solution.

CHARACTERISTICS

In appearance this preparation resembles diluted milk or whipped cream, according to its concentration and to the stabilizing solutions, and its surface darkens to a bluish grey when exposed to light. Finely subdivided in its colloidal form, its minute masses are negatively charged, moving to the positive pole. Its physical and chemical characteristics render it well suited for intravenous injections except for the acacia and dextrose or glucose which tend to cause serum-like reactions at times.

The size of the small masses in the colloids vary according to its preparation, from those so small that they cannot be seen to the larger ones, which are readily visible with a dark field microscope as actively motile masses about the size of micro-organisms such as the staphylococcus or larger. Colloidal silver chloride is miscible with feces, urine, blood, gastric juice and pus, and retains its colloidal characteristics for a few days to a week or longer according to conditions. It is necessary to check the quality of the preparation by the dark field examinations and the toxicity by intravenous injections into rabbits.

AFTER INTRAVENOUS INJECTIONS SOME OF THE COLLOIDAL BODIES IN THE BLOOD ARE PROBABLY TAKEN UP BY THE LEUCOCYTES

The fact is well recognized in physiology that the leucocytes (phagocytes, "devouring cells"), take up small foreign substances circulating in the blood stream. Our work so far leads us to believe that some of these colloidal bodies are taken up in this manner. The leucocytes have also another mission, namely, to accumulate at the points of inflammation and thus apparently they tend to concentrate the intravenous colloidal germicide where it is most needed.

Furthermore, Foot (Journal Medical Research, 1919, xl, 353) and others have found that proliferating vascular epithelium is markedly phagocytic. These facts help to explain the curative results of colloidal silver chloride in certain chronic inflammations where the doses given were obviously too small to be of value unless they did in some way become concentrated at the focus of infection.

MANGANESE INJECTIONS

From a theoretic standpoint, chronic tuberculosis would afford ideal conditions for such a plan of treatment.

We have apparently cured two patients with tubercular epididymitis by intravenous injections, while a third remains little changed by the treatment for the probable reason that there is an abscess cavity in which the germicide cannot reach the organisms. We think, however, that drainage followed by another course of injections may be effective.

We are now working to obtain a preparation in which the stabilizing solution of acacia, dextrose, etc., may be so balanced as to minimize the reactions. While our results in many conditions have surprised us by their good results, we have been just as much disappointed with streptococcic and other septicemias and unless this remedy proves safe in larger doses than those so far employed, it will not be of value in these conditions.

We realize that our experimental work so far is inadequate and we reluctantly make this report, yet some of the results have been so strikingly good that we desire to go on record with the preliminary facts, and hope that it is within the range of possibility to secure an intravenous germicide which in certain conditions may accumulate in sufficient concentration in inflamed areas to effect a cure. There are at least opened an interesting field for work, a mild remedy to work with and some fanciful theories to prove or disprove.

DISCUSSION

Dr. Guy L. Hunner, Baltimore: I was greatly interested in both of these papers and think we have a great deal to work on in getting at something of the sort Dr. Ballenger presented, particularly in treating general blood infection.

A word in regard to Dr. Stirling's paper. First of all, a criticism of his terminology. I think we should give up the term "pyelonephritis" as the general term for these infections that are so purely of the pelvic type. To be sure, we do in almost all pyelitis get evidence of involvement of the kidney substance. A good deal of albumen and some blood that may be coming from the kidney substance, and definite casts showing that the kidney substance is involved, but, as you all know, this evidence of the kidney substance involvement is gone within a very few days of the acute onset. So I think we should reserve the term pyelonephritis for the definitely surgical kidney. Of course, we get the infected hydronephrosis case and the other cases that represent advancing stages of pyelitis.

As to the focal infections and the part they play in this—as you know, I have been interested in this for many years and have been tremendously interested in the recent work at the Mayo Clinic proving a great many theories, from the laboratory point of view, that I have held from the clinical point of view for a long time. I think there is still some difference of opinion as to the part of the focal infection. My idea is that the focal infection is the primary cause of most of these pyelitis cases. The original focal infection is probably sifted out by the lymphatic glands near the ureter, and then the inflammation goes over into the ureteral wall and by the time we see the patients they do not have a streptococcus pyelitis but a colon bacillus pyelitis. That is evidence, it seems to me, that the teeth or tonsil infection is really not a direct cause of what they come to us for, pyelitis. It does invade the ureteral wall, there is inflammation which leads to stasis, and then the patient gets a traumatic injury, or gets pregnant, or has a gastro-intestinal upset, something that causes a swelling and edema at the site of the ureteral stricture, and then the colon bacilli find the static urine a good place, set up housekeeping, and so the patient comes to us with a colon bacillus pyelitis.

Dr. I. S. KOLL, Chicago: I have for many years been interested in the subject of pyelitis and pyelonephritis. In 1911 and 1912 I conducted quite a number of experiments and think my work was later substantiated by Dr. George Smith of Boston. If we are to draw any conclusions from our laboratory work, I think we can state that there is no such pathological entity as pyelitis. It is impossible to get an infection in the pelvis of the kidney without the deeper structures becoming involved. There is no question but that we do have clinical symptoms whereby the pelvis of the kidney only presents involvement that does clear up. What these kidneys would show histologically in the patient I do not know, but I am inclined to think that we must consider every pelvic infection as not limited to the pelvis.

Dr. GEORGE R. LIVERMORE, Memphis, Tenn.: I think we owe Dr. Ballenger some thanks for his work on this subject. For years I have been interested in the intravenous injection of some preparation which would help these patients combat the infection from which they are suffering. Years ago Hume did some work at Johns Hopkins in the injection of silver nitrate, but finally gave it up. Some years ago continuing Hume's work I injected nitrate of silver with gratifying results. I think it acted as a vaccine and stimulated the formation of antibodies, which resulted in the benefits derived, rather than as an antiseptic, for it was in such a weak solution it could not be expected to act as a germicide. After using it for years and getting some happy results in some cases and in others none at all, we tried the injection of collargol and in several cases of pyelonephritis where the patients life seemed to hang by a thread and there is no doubt that something benefitted them. These patients were given collargol intravenously and immediately began to get better, whereas for days and sometimes for weeks they had been at death's door. This seems to prove that these extraneous substances put into the circulation do some good. In some cases where the patient died, careful search was made in the liver spleen and kidneys, for particles of the collargol, but none could be found or demonstrated, which seemed to show that it was a more or less harmless substance to use. Dr. Ballenger brought out so fully the harmlessness of the preparation of colloidal silver that it behooves us to follow out his work and have something substantial to report at the next meeting.

Dr. Irving Simons, Nashville, Tenn.: In discussing Dr. Stirling's paper, I do not think that urologists have thoroughly convinced the general medical profession that pelvic lavage is the best thing for pelvic infection. I think part of that has been due to the fact that we have been a little careless in the selection of our cases. In a study of cases gathered from the literature and treated by men throughout the world, it was found by analysis that about three washings would cure the average cases. (I. Simons, Pelvic Lavage, Rpt. Amer. Urolog. Assoc., 1917.) If it is necessary to continue more than five or six washings there must be some reason, which leads me to believe that pelvic lavage is not indicated in all cases and should certainly not be done to the exclusion of everything else. I think that while Dr. Stirling mentions pyelography, he did not stress it sufficiently. I have thought many times that I do not pyelograph enough. I think in many acute cases pyelography can be done without harmful results, and if one finds some anatomical distortion—like a water trap ureter, a kink or a twist—one cannot hope to get as good results in those cases as in others.

In regard to Dr. Ballenger's paper, I would like to have him tell us something about the preparation of the material he reports so favorably upon, and whether it is made in their own laboratory.

Dr. J. S. Read, Brooklyn: I was very much interested in Dr. Stirling's paper, and have been particularly impressed with those cases of chronic pyelonephritis—which I think is a correct term—and with the after-care of the patients. When they are seemingly cured, I believe we should have them report at regular intervals for pelvic lavage, for the kidneys often become infected later on.

In relation to pyelograms, I wish to give a warning from two cases. One young man had a double pyelogram, with proper gentle technic, but passed no urine for thirty-six hours. A second case, seen a year earlier, had a double pyelogram and complete suppression for forty hours. In both cases fresh sodium bromid solution was used.

Double pyelograms are not free from risk and when they are to be done, the patient should receive extra careful preoperative and postoperative care.

Dr. MAX LAUTERMAN, Montreal: I have been working with solutions of colloidal silver and colloidal nitrate of silver. I must confess that I spent a night with McDonough and came back charged with everything he had to offer. I believe in trying everything that is introduced to me and I must confess that I have had some results. I look forward to the future with great enthusiasm and think if Dr. Ballenger will make it possible for us to work along with him we will have something very interesting to report at the next meeting. There is no question that life is not the central problem. There is the question of biochemistry and especially colloidal chemistry for observation, but I believe we are on the threshold of some very excellent things.

Dr. W. G. EXTON, New York: In connection with the mild chronic cases there is a point which is seldom touched on in literature or discussion. I refer to the frequency with which gastro-intestinal symptoms, hyperchlorhydria, etc., mask the real cause of the trouble. I think that all cases of obstinate hyperchlorhydria with pus in the urine should be carefully examined for renal disease, because I have seen very intractable cases yield in a surprisingly short time to proper treatment of the renal condition.

The general practitioner has to some extent learned to look to urology for help in critical cases with obscure abdominal symptoms, but we have, I think, not informed him as well as we might of the value of urology in the milder cases.

Referring to Dr. Ballenger's paper, I was at one time keenly interested in Professor Crede's work with colloidal metal preparations, and have always had the feeling that while his colloidal silver did not meet experimental expectations, the therapeutic possibilities of the colloidal metals were far from being exhausted. I therefore feel we should encourage Dr. Ballenger all we can in his work.

Dr. N. P. **Rathbun**, Brooklyn: In connection with Dr. Stirling's paper, I think the focal infections are of great importance. The reason we have fallen down on them is because we have not done the laboratory investigation with sufficient care. We get the colon bacillus and are satisfied. I think by careful culture we will get the streptococcus in a much larger proportion of cases. It is interesting in removing teeth and tonsils from which the streptococci are recovered that they can also be recovered from the urine. They can be excreted through the urinary tract in the same way the tubercle bacilli are, without infecting the kidney or they produce infection.

Another thing is that wherever an infection is present we must provide effective drainage. Two things interfere with this drainage. One of these is stricture of the ureter. I think many of the cases treated by pelvic lavage are improved quite as much by the passage of the catheter as by the lavage.

Another thing is the freely movable kidney. Nephropexy has become more or less obsolete, but I still believe it has a proper place in kink of the ureter and obstruction. Infections will not get well until these things which interfere with adequate drainage are removed.

Dr. **Bransford Lewis**, St. Louis, Mo.: I have been much impressed with a phase of renal symptomatology coming from obstructive processes in the bladder, including women as well as men. One very striking case was that of a man who was a member of a band, and in a political celebration participated in the parade. He suddenly got a severe pain in the lumbar region, had to stop playing, and was sent to his doctor who, from the symptoms, diagnosed the possibility of a kidney stone. He was sent to me immediately for relief from the stone. I investigated and found not a stone, but marked obstruction from a contracture at the neck of the bladder that produced about ten ounces of residual urine. I looked on the renal pain as reflected from the prostatic obstruction. It cleared on relieving the latter.

Another case was strikingly similar to this and I have had others in which there was urethro-trigonitis with bladder symptoms in women. The symptoms cleared up upon relief of the stricture at the neck through dilating with Kollmann dilator.

I think this should be recognized in connection with lavage of the kidney, because if it is not recognized you can lavage until doomsday without giving relief. Stricture at the neck of the bladder as well as in the ureter is of importance in this relationship both in the male and female.

Dr. H. D. Furniss, New York: I should like to emphasize the importance and seriousness of pyelitis in pregnancy. In my experience there is a much greater tendency to ureteral and pelvic dilatation at this time, and unless treated strenuously right in the beginning the infection of the kidney may eventually lead to its destruction although many of the cases clear up on the completion of pregnancy. I do not think that such an event should be awaited, but that they should be treated strenuously from the start. Even in the ones that cannot be gotten pus-free the pelvic destruction can be kept down.

I have always thought that in nitrate of silver we had the best drug for use in the kidney. The good results come from the reaction set up rather than the antiseptic value.

Dr. W. C. Stirling, Winston-Salem, N. C. (closing): As regards terminology in these kidney infections, I think it is more or less arbitrary.

The thing that impressed me most in the thousand autopsies I saw, most of them in the base hospitals in France, the pathologists were not sure whether it was pyelitis or pyelonephritis. Over 70 per cent of the cases showed cloudy swelling and more or less round cell infiltration around the walls of the kidney, showing that there was more than a simple pyelitis. I think most of you will agree that the clinical symptoms in these cases are more than the symptoms of infection.

In a case of pyelonephritis, not of pregnancy, the women had thirteen chills and a temperature of 105°F. Upon passing a catheter and draining the kidney the temperature came down and stayed down.

Dr. E. G. Ballenger, Atlanta, Ga. (closing): Some rather interesting work has been done in the Rockefeller Institute with manganese oxide, in the colloidal state, injecting it into cats and other animals, to see where it is chiefly deposited. It has been found that in cats about 47 per cent is deposited in the lungs and the rest in the liver, kidneys, spleen and other organs. Certain liver cells (Kupfer cells) seem to be particularly active in taking up these minute bodies.

The method of making colloidal preparations is simple but requires some care. They may be made if nitrate of silver in one solution and silver sodium chloride in the other are rapidly mixed. Acacia and dextrose or acacia and glucose are used as stabilizers. The dextrose when boiled is alkaline in reaction, while the acacia is acid. By properly combining these you make a neutral preparation. There are two tests which should be employed to determine if the preparation is satisfactory: (1) It is observed with the ultramicroscope to see the size of the colloidal bodies; (2) it is tested with tin foil or a nickle spoon to see if there is any corrosive action. If there is, it means all of the nitrate of silver has not been neutralized.

We have not yet determined the minimum lethal dose for rabbits or the minimum effective dose.

A patient with tuberculous epididymitis of six months duration, with a fistulous tract and positive smears, was given intravenous injections of 1 to 4 cc. doses of a 1 per cent solution every other day. Within fourteen days the smears were negative for tuberculosis and have been so for a month, during which time seventeen tests were made.

Another patient with tuberculous epididymitis without a fistulous tract failed to respond to the similar treatment. The swelling was more extensive and there was a large accumulation of pus.

RENAL TORSION[1]

WILLIAM F. BRAASCH

Section on Urology, Mayo Clinic, Rochester, Minnesota

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The normal position of the kidney as described in Gray's Anatomy is as follows: "The kidneys are situated on either side of the vertebral column so that their upper extremities are on a level with the upper border of the twelfth thoracic vertebra, their lower extremities on a level with the third lumbar. The long axis of each kidney is directed downward and lateralward, the transverse axis backward and lateralward." The position of the kidney is further described as being such that the hilum lies opposite the anterior surface of the vertebral column in an anterolateral position, the pelvis being next to the median line and the calices extending laterally from it. It will be remembered that in the embryo the mass of nephrogenic tissue with the ureteral buds ascends gradually from the bony pelvis until it reaches its normal lumbar position when the embryo has attained a length of approximately 10 mm. As it approaches the permanent position the kidney rotates so that the hilum and the renal pelvis, which were situated anteriorly, now lie adjacent to the vertebrae. Similarly the ureter, which during its ascent extends directly caudad to the anterior aspect of the pelvis, with normal rotation assumes a relatively median position.

Not infrequently in the course of pyelography, abdominal exploration, or necropsy, a marked deviation from the normal in the relative position of pelvis and calices is found. Instead of the normal degree of rotation, the kidney may be situated so that the pelvis lies entirely anterior to the calices, or the normal relations may even be reversed so that the calices are median to the lateral lying pelvis. Such renal torsion may be of two types, congenital and acquired. In the early embryo the relative position of the embryonic renal pelvis to mesonephric renal cells is such that the former lies distinctly anterior to the latter. With congenital anomaly of position, such as occurs with ectopic and fused kidneys, the embryonic renal tissue is permanently arrested in its ascent, and the pelvis retains the relatively anterior position. When, however, one pole of the fused kidney ascends to a relatively normal position, as often occurs, its pelvis may partially rotate and assume a more normal position. The position of the kidney arrested in its ascent may also be affected by the blood supply. When the renal artery arises from the iliac arteries, as occurs with true ectopic kidney and occasionally with fused kidney, the short pedicle may exaggerate the anomaly in position. Occasionally a kidney is observed which is not truly ectopic, since its blood supply does not arise from the iliac arteries but from the aorta. The kidney is not in the pelvis, but it may be fixed at a level distinctly lower than normal. Normal rotation has not occurred and the renal pelvis remains distinctly anterior (fig. 1).

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[1] Read before the thirty-fourth annual meeting of the American Association of Genito-Urinary Surgeons at Washington, D. C., May 1, 1922.

Owing to differences in the rate of development of the two segments of a fused kidney, as well as to other factors, the renal pelvis may be situated so that there is a complete reversal of the normal relative position of pelvis and calices (fig. 2). As a result the pelvis is situated laterally and the calices extend toward the median line. With failure of rotation and anomalous renal position, the ureter may be situated so that it leaves the renal pelvis from its lateral instead of median border (fig. 3).

Renal torsion may result from factors other than congenital, which may best be termed acquired. The most common factors causing rotation of the kidney are renal ptosis, extrarenal pressure, intrarenal tumor, perinephritis, and trauma.

Renal ptosis. Acquired renal ptosis may be the result of many factors, floating kidney probably being the most common. As might be expected with a freely movable kidney, its long axis is often changed from the normal vertical status so that the pelvis

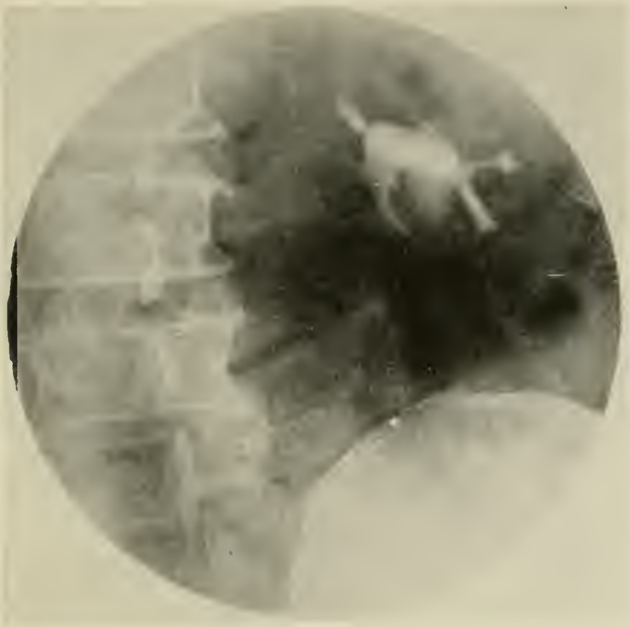

Fig. 1. Anterior Rotation of the Pelvis with Torsion of Calices in Horseshoe Kidney

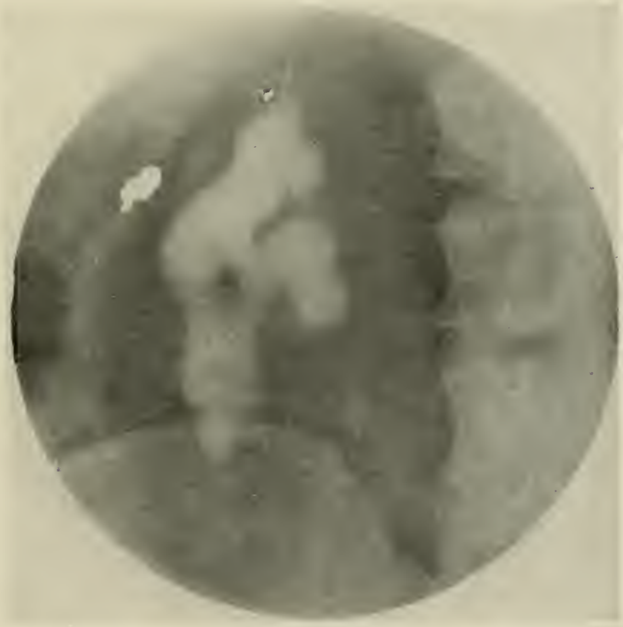

Fig. 2. Complete Reversion of Calices as a Result of Torsion with Fused Kidney

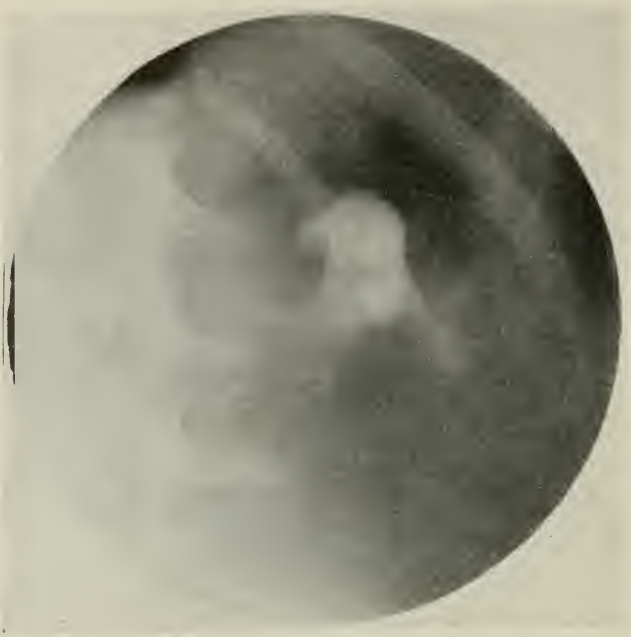

FIG. 3. TORSION RESULTING FROM FUSED KIDNEY

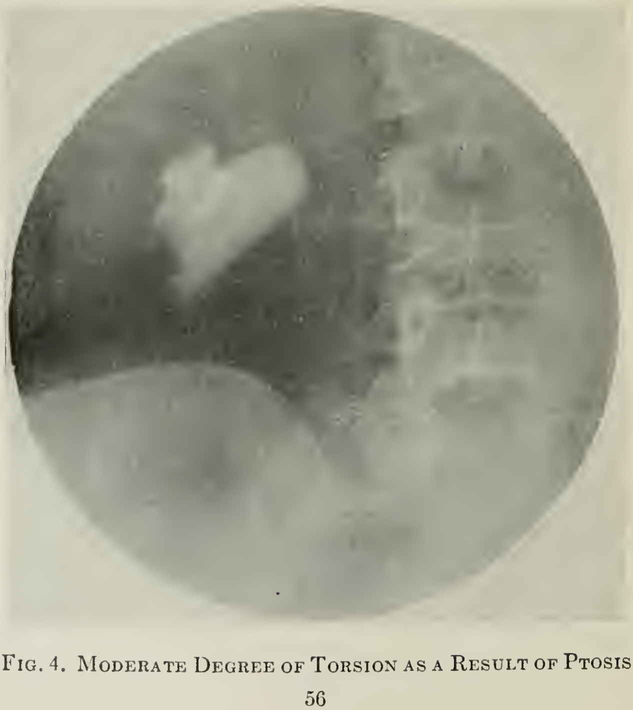

FIG. 4. MODERATE DEGREE OF TORSION AS A RESULT OF PTOSIS

may extend horizontally. With it there is often rotation of the pelvis from its normal median position to an anteror or even lateral position (fig. 4). A slight degree of dilatation of the calices, and even to a less extent, dilatation of the pelvis may often be observed with the torsion. To what extent the anomalous position of the pelvis resulting from ptosis actually obstructs urinary drainage is open to question. The acute attacks of abdominal pain, or so-called Dietl's crises, which are often noted with renal ptosis, lead one to infer that the abnormal position might well be a factor. Furthermore, the dilatation of the minor calices, and, to a more moderate degree of the major calices and true pelvis, which is often observed strengthens the theory of actual obstruction. Nevertheless, at operation there is frequently no evidence that the rotated kidney has caused actual constriction of the ureter. It would be logical to assume that another factor, such as the pressure of an extrarenal organ or band of tissue, is the direct cause of temporary obstruction and that ptosis is only a secondary factor.

Extrarenal pressure. Displacement of the kidney as a result of extrarenal pressure may be caused by extrarenal tumor, perinephritis, and spinal deformity. The kidney may be displaced in any direction by an extrarenal tumor. As a result it is not unusual to find it over the vertebrae under the tenth or eleventh rib (fig. 5) or in the bony pelvis. At the same time there is frequently more or less torsion. With the rotation of the renal pelvis there may be a definite narrowing of the lumen as the result of pressure from the extrarenal tumor (fig. 6). The resulting deformity may occasionally be difficult to distinguish from deformity subsequent to intrarenal tumor.

Intrarenal tumor. Intrarenal tumor occasionally causes torsion of the renal pelvis either as a result of displacement or by actual encroachment on the pelvis by the invading tumor. A large solitary cyst in one pole of the kidney may change the normal axis of the pelvis, or at least of one or more calices.

Perinephritis and trauma. With marked perinephritis and subsequent cicatricial retraction a considerable degree of renal rotation may be observed. This is often illustrated by the

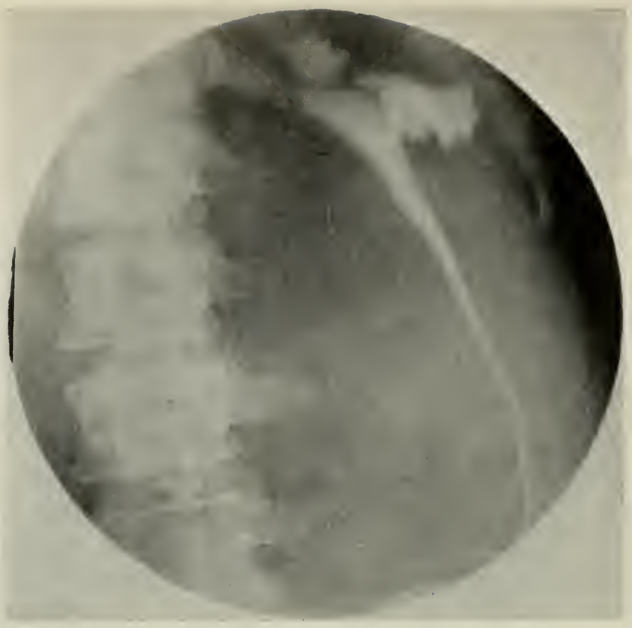

Fig. 5. Upper Displacement of the Renal Pelvis with Torsion of Calices Resulting from Pancreatic Cyst

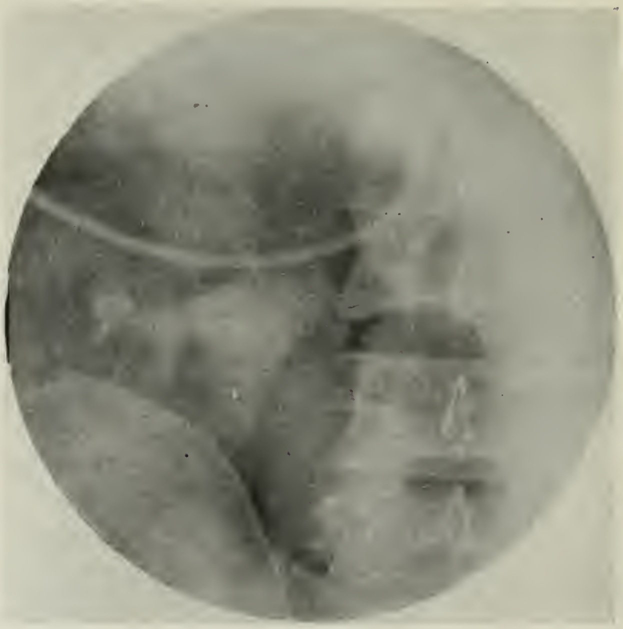

Fig. 6. Torsion as a Result of Displacement by an Overlying Extrarenal Tumor

unusual position in which an infected kidney is found at operation when it is surrounded by fibrous adhesions which have resulted from extensive perinephritis. A pyelogram made following nephrolithotomy often shows considerable torsion resulting from the manipulation of the kidney. With trauma of the spine and consequent perispondylitis the position of the kidney may be affected either directly by the exudate or by the cicatrix resulting (fig. 7). Extensive pleuritic effusions may cause displacement of the kidney. As a result of renal trauma the kidney may be deformed, which, with perirenal cicatricial retraction, may cause marked renal torsion.

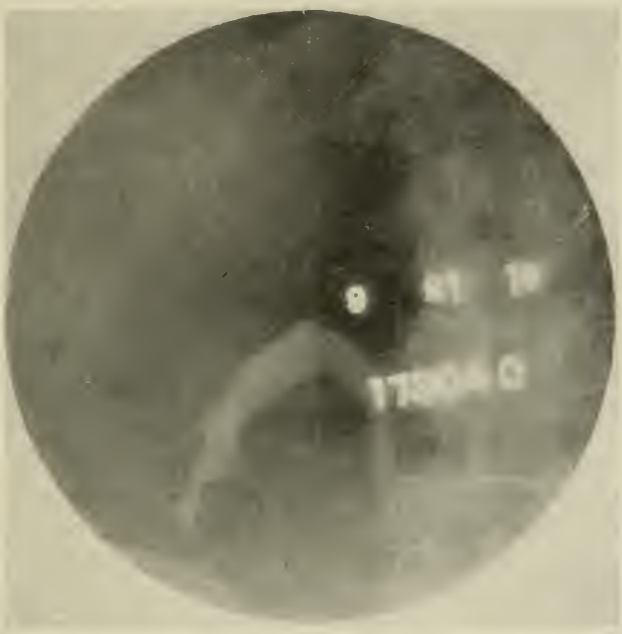

Fig. 7. Displacement of the Renal Pelvis, with Torsion and Obliteration of Calices as a Result of Intrarenal Tumor

CLINICAL SIGNIFICANCE

The existence of renal torsion per se is not of great clinical significance; nevertheless, it may be a factor in the etiology of hydronephrosis which so often develops with fused and ectopic kidneys. The acute angle at which the ureter leaves the anterior-lying pelvis might well be a factor. Acquired torsion is even less often of clinical significance, although in some cases it is the only factor which can be discovered to account for the evidence of urinary obstruction. If, with marked rotation of the renal pelvis, there is also fixation of the upper ureter it would seem probable that the abnormal relation of pelvis and ureter might be a factor in interfering with urinary drainage.

DIAGNOSIS

On abdominal palpation the anteriorly rotated kidney may occasionally be felt through a soft thin abdomen as a ridge-like mass. As a rule, however, the clinical diagnosis of renal torsion can be made only by means of pyelography. The abnormal position of the rotated pelvis is usually readily recognized in the pyelogram. In the anterior-lying pelvis the outline of the calices may be superimposed on that of the pelvis so that a confusing picture results. As a rule, however, the calices are either outlined head-on by round areas of accentuated density, or they may be observed extending distinctly median to the lateral lying pelvis. The ureter, particularly with horseshoe kidney, is often seen leaving the pelvis distinctly laterally instead of directly anteriorly. Occasionally it takes a winding, irregular course, extending upward or laterally as it leaves the renal pelvis. With acquired renal ptosis a wide range of abnormal rotations of the pelvis may be observed. Tilting of the pelvis from its usual perpendicular axis is common. Rotation so that the pelvis is situated anteriorly is also often observed. Occasionally the torsion is complete and the normal lateral position of the calices is reversed. Displacement by extrarenal factors is not uncommon. As a result of extrarenal tumor the pelvis may not alone be displaced in any direction, but abnormal rotation is not uncommon, although it seldom occurs to the degree observed with anomaly and is seldom sufficient to cause urinary obstruction. Demonstration of torsion of the renal pelvis may be the only evidence of the perinephritic nature of the tumor in the flank. As a result of trauma to the kidney or to the spine, or of perispondylitis, the pelvis may be fixed in an abnormal position after the acute symptoms have subsided. Occasionally rotation with a moderate degree of dilatation of the pelvis is observed following a fall, or a blow over the kidney, even though there may have been no actual rupture of the kidney. This condition has been termed traumatic hydronephrosis (1). Similarly, rotation without ptosis together with a moderate degree of hydronephrosis is occasionally observed when no definite clinical etiologic factors or history of trauma are present. With this condition the severity of the clinical symptoms may be much greater than the degree of dilatation or rotation warrants.

REPORTS OF CASES

Case 1 (*A381345*). Mrs. P. R. B., aged forty-two years came to the Clinic complaining chiefly of attacks of pain originating in the left loin and radiating anteriorly. The pain was so severe that chloroform was used for relief. A cholecystectomy and appendectomy had been performed elsewhere four years before.

The general physical examination including Wassermann test and roentgenograms of the urinary tract and colon was negative. Urinalysis showed only occasional pus cells, and the phenolsulphonephthalein return in two hours was 55 per cent. Cystoscopic examination revealed a normal bladder with apparently clear urine from both kidneys. A catheter was introduced into both ureters to a normal length and the catheterized specimens were normal. On differential functional test the dye made its appearance in three minutes from both sides; the return in fifteen minutes was 15 per cent from the right side, 14 per cent from the left side, and 3 per cent from the bladder. A pyelogram of the left kidney showed definite renal torsion and moderate dilatation of the pelvis and calices. A diagnosis was made of small hydronephrosis with renal torsion. At operation a hydronephrosis was found with a capacity of about 60 cc. The kidney was fixed and lay nearly transverse as a result of torsion. It was freed from its bed, placed in a normal position, and decapsulated, the capsule being used to hold it in position.

Case 2 (A68850). Mrs. J. F. aged forty-eight years gave a history of a severe attack of right anterior abdominal pain with nausea and vomiting, occurring two years before she came to the Clinic, and a similar attack three months before, which lasted two days.

The physical examination was negative save for a mass slightly movable in the right hypochondrium. Urinalysis and roentgenograms of the urinary tract were negative, and the renal functional test was normal. Cystoscopic examination revealed torsion of the right renal pelvis. A clinical diagnosis was made of possible renal tumor.

At operation the mass was explored through an anterior incision and was found to be a dystopic right kidney. The kidney was lobulated and the pelvis rotated anteriorly and cephalad so that the ureter was drawn tightly over the surface of the kidney. The hilum of the kidney was directed upward and held there by firm bands of peritoneum. The arterial supply had its origin in the aorta. The bands of peritoneum were loosened, the kidney replaced in a normal position and the peritoneum closed. The gallbladder, which was definitely inflamed was removed. There was an anomaly of the hepatic artery and portal vein which lay across the common duct. Convalescence was uneventful and the patient left the hospital on the thirteenth day.

CONCLUSIONS

1. Incomplete congenital rotation and acquired torsion of the kidney while of anatomic interest are of no clinical importance *per se.*

2. The anomalous position of the renal pelvis and its relation to the ureter may, in certain cases, permit urinary obstruction by some extrarenal factor.

3. Traumatic hydronephrosis without direct injury to the kidney may occur following a fall or blow, which is accompanied by renal torsion and fixation of the upper ureter by adhesions.

4. Renal torsion without evident ptosis, or other known etiologic factors, may occasionally occur with a moderate degree of hydronephrosis.

REFERENCE

(1) Herrick, F. C.: Trauma as a factor in the etiology of hydronephrosis (pyelectasis). Jour. Urol., 1921, vi, 1–17.

A CASE OF REDUPLICATION OF LEFT URETER AND LEFT RENAL PELVIS[1]

R. F. O'NEIL

Massachusetts General Hospital, Boston, Massachusetts

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Since the wider application of the pyelogram and the ureterogram anomaly of the urinary tract are found to occur more frequently than was formerly supposed. Still they are of sufficient rarity to warrant putting on record such cases as the following. It is a well established fact that given an anomaly of the urinary tract, the abnormal organ is the one which is much more prone to be the site of any disturbance than is a normal organ, and when any abnormalities are found it is of interest to determine whether or not they are the cause of existing symptoms. The history of the case is as follows:

Mrs. X. Twenty-eight years of age, married. Referred by Dr. James L. Huntington of Boston, for diagnosis as to the cause of pain in the left loin and frequent micturition. The pain in the left loin began during her only pregnancy, four and one half years ago. During the last six weeks of pregnancy, the pain was severe, she also had frequency of micturition and was told that she had albumin in her urine at that time. There was a hard labor with a breech presentation. Her convalescence was normal and uneventful. At the present time she complains of a constant pain and ache in the left loin. This is not relieved by lying down and the pressure of her corset causes discomfort. There is urinary frequency of about once an hour during the day and nocturia for from five to seven times. There is some nausea just before menstruation when all symptoms are aggravated. Two months ago she had a bad fall on the ice striking the left side. Since then the pain has been very much worse.

Examination shows a thin woman. Abdomen, right rectus scar from appendix operation when she was thirteen years old. Both kidneys are palpable. The left more easily than the right. Neither is tender. Pelvic examination moderate prolapse of the uterus. Otherwise negative. Nothing found which would cause symptoms. On standing, the posture is faulty and there are definite signs of ptosis. There is also localized tenderness on the left side of the spine in the region of the second lumbar vertebra. In view of the urinary frequency and the pain in the loin, cystoscopic examination and pyelogram was advised. Catheter specimen of urine was clear, contained no albumin, no sugar and the sediment a few epithelial cells only. There may have been a pyelitis present during her pregnancy, but if so no trace remains at present.

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[1] Read at the meeting of the American Association of Genito-Urinary Surgeons, Washington, May, 1922.

Cystoscopy. The urethra was tight to the passage of an ordinary cystoscope. The bladder mucous membrane was normal. On the right was a normal appearing ureteric orifice. On the left, in the usual position was a normal appearing orifice. Immeditely posterior to this was a second orifice also normal in appearance. Both of these on the left were catheterized with no. 5 radiograph catheters. The catheter in the anterior opening passed apparently to the renal pelvis and drained clear, normal looking urine. The catheter in the second orifice could not be passed as far up the ureter as the other. This one also drained clear, normal looking urine, but less in amount than the other. The cystoscope was then withdrawn and reintroduced and the right side catheterized to the renal pelvis, from which a normal ureteric flow of clear urine was obtained. Examinations of the urines from the kidneys showed from the right, occasional blood cell, otherwise negative. From the left, first opening, red blood cells only. From the second, red blood cells only. Cultures were sterile from all specimens. Renal function, 1 cc. phenolsulphonephthalein intravenously. Appearance time, right side, seven minutes, 15 per cent excreted in fifteen minutes. From the left side, from the first ureteric orifice (anterior) appearance time, two minutes 35 per cent in fifteen minutes. From the second orifice (posterior) only a trace of color was excreted in fifteen minutes, the appearance time being nine minutes. Taken to x-ray room, sodium bromide solution, 25 per cent was injected. On the right 5 cc., on the left, in the first ureter, at first 3 cc. and later 8. In the second ureter, at first 2 cc. and then 4 more. The x-ray report is as follows: In the plates taken after the catheters were in position one catheter is visible on the right and two on the left. There is no evidence of shadows suggesting stone in any portion of the urinary tract. One of the catheters on the left side passes well up into the upper pole of the kidney. The tip of the other is opposite the transverse process of the fourth lumbar vertebra. The kidney outlines are visible on both sides. The left is nearly double the size of the right. After injection of the opaque mixture the outline of the right kidney pelvis is well shown. It appears to be normal in shape and size. The calices are also distinctly normal in appearance. On the left, a small abnormal pelvis is visible in the

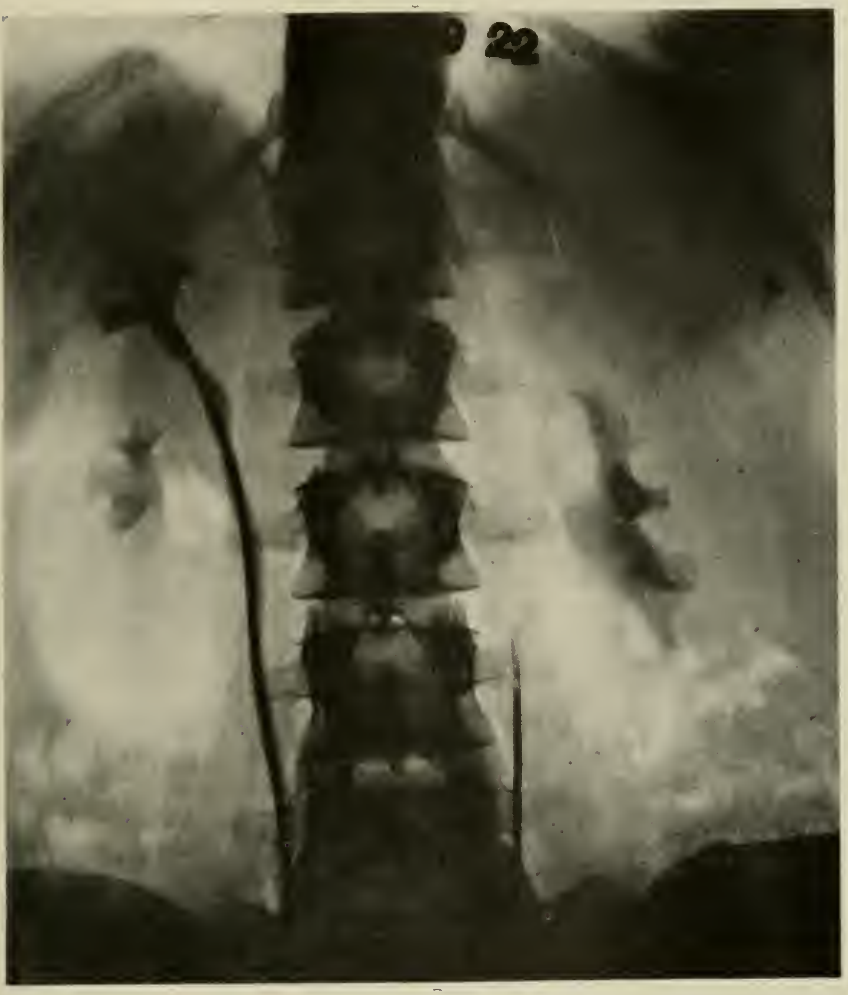

Fig. 1. Reduplication of Left Ureter and Left Renal Pelvis

upper portion of the renal shadow. In the lower portion a slightly larger, but definitely abnormal pelvic shadow is seen. The course of the second ureter is not outlined.

Findings. Anatomical variation of the left kidney. The x-ray findings in this case conform to the rule in such anomalies that the normally situated ureteric orifice is the one of the upper pelvis of the kidney. There was no reaction following the cystoscopy or the pyelogram, and in a couple of days urinary frequency had greatly improved, the intervals during the day being lengthened to several hours and the nocturia diminished to once or twice. I attribute this improvement to the dilatation of the urethra by the cystoscope, as there was certainly no cause to be found in the bladder or the urine to account for it otherwise.

This patient presented, on examination, signs of a certain amount of ptosis and faulty posture, and while a definite anatomical abnormality of the left kidney was found, there was no evidence that there was any renal obstruction, infection or dimunition of function other than one segment of the kidney was more active than the other. In view of this it seemed wise to have an orthopedic consultation, with the idea of a proper support for the abdominal organs and a correction of the posture to see if the symptoms could be relieved in this manner before suggesting any surgical procedure for the fastening up of the kidney. Although I have no doubt that the heavy organ on that side accounts to a considerable degree for her long standing pain and which may have become more prolapsed following the fall on the ice two months ago.

She was seen by Dr. R. B. Osgood at my suggestion, who makes the following report:

I find no evidence of bone or joint lesions, but very definite signs of ptosis and faulty posture, and a definite and sharply localized tenderness over the transverse process of the second lumbar vertebra. There seems to me also to be a little thickening in this region Although the x-ray is negative to any bone lesion, I feel that in her injury she bruised, and perhaps tore off some of the muscle attachments to this transverse process, to which she has never given any real protection. I shall hope by correcting her posture, giving her support which will not press upon this region, but protect it from muscle strain, the condition could be gradually relieved.

Such a support was made for this patient, and although she has only been wearing it a short time, there is practically complete relief from pain, which, however, recurs at times when the support is removed. The day frequency of micturition having entirely disappeared and nocturia has been reduced to once. This improvement, as I said, I attribute to the full dilatation of the urethra, as it occurred before any supporting apparatus was worn. It seemed to me as if the pain in this case was largely caused by the ptosis of the heavy, enlarged left kidney, aggravated by the injury. Whether or not surgery is to be advised will have to be determined by the permanency of the relief afforded by the correction of the general ptosis and the improvement of the general condition.

SOME CASES OF HYDRONEPHROSIS[1]

R. F. O'NEIL

Boston, Massachusetts

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The 3 following cases recently seen by the writer are of interest because of the extensive renal pathology which was found. They belong to the group of cases presenting pain in the upper quadrant of the abdomen without any so-called urinary symptoms, or any gross abnormality in the urine. These cases generally pass through many hands and are often the objects of surgical assault on various unoffending organs without relief, the kidney remaining unsuspected because of the absence of any disturbance in the urinary function or any change in the urine, combined with the negative physical examination. This is rather remarkabe because they present a typical history of renal colic, very suggestive of calculus and only to be differentiated from it by means of the x-ray and the injection of the urinary tract with some opaque solution. By means of pyelography and ureterography a renal lesion and its underlying cause are readily differentiated from one outside the urinary tract and with the constantly increasing use of these methods the cause of upper quadrant pain should be determined with greater frequency and accuracy. The case histories are briefly as follows.

It will be noticed that in one case a diagnosis had been made of left-sided appendicitis. Operation without relief. In another gall-stones. In the third, no diagnosis has been made with the exception of possible lead poisoning, but the patient had been advised to have the genito-urinary tract studied. The pain in all these cases was of the same type, severe, paroxysmal and at times associated with nausea. In 2 cases it was local in the loin, and in the third it was, first in the loin, and later referred to the groin. In none of them was there any variation in the urinary function. In 2 cases the urine was absolutely normal. In the third there was the slightest trace of albumin, a rare red blood cell and an occasional hyaline cast.

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[1] Read at the meeting of the American Association of Genito-Urinary Surgeons, Washington, D. C., May, 1922.

Case 1. R. Twenty-three years old, married, clerk.

Complaint. Pain in the left loin. Numerous attacks during the last six years. The more recent attacks having been associated with nausea and requiring the injection of morphia. They last a varying length of time and leave a soreness in the loin after they have passed off. The last attack from which he has just recovered was the most severe he has had, lasting four days. There have never been any urinary symptoms. Seven months ago an operation for appendicitis was performed. According to the patient's statement, the surgeon told him he had left-sided appendicitis. No relief since the operation. In fact, the attacks have been more frequent and more severe.

Examination. Well developed and nourished young man. Abdomen, negative except for right rectus scar from previous operation. No masses, no tenderness. Chest, genitals and extremities normal. Urine: catheter specimen; clear; no shreds; normal color; acid; specific gravity 1.022; no sugar; albumin slightest possible trace (heat test); sediment; rare red blood cell; rare hyaline cast.

Cystoscopy. Easily done, bladder and ureteric orifices normal. Left side catheterized without obstruction to the kidney pelvis. Rapid, steady flow of clear urine 120 cc. before flow became interrupted. Blue colored solution injected into the renal pelvis, did not reappear in the bladder. Analysis of the urine from the left kidney: clear; specific gravity 1.018; albumin slightest possible trace; occasional red blood cell; occasional hyaline cast. Culture showed no growth. Sent to x-ray room, 50 cc. (plus) sodium bromide solution 25 per cent injected through the catheter without symptoms. Pyelogram and x-ray report: Plates show no evidence of stone in any part of urinary tract. Outline of the right kidney visible. Normal in shape, size and position. Left kidney not made out. Radiograph catheter enters the pelvis of the kidney in an abnormal position. The shadow of the kidney pelvis after injection is distinctly abnormal. It is much increased in size. The calises are markedly dilated, but the cuppings are not entirely destroyed. On withdrawing the catheter and injecting the ureter, a definite kink is visible close to the junction of the ureter with the kidney pelvis.

Diagnosis. Hydronephrosis due to kinked ureter.

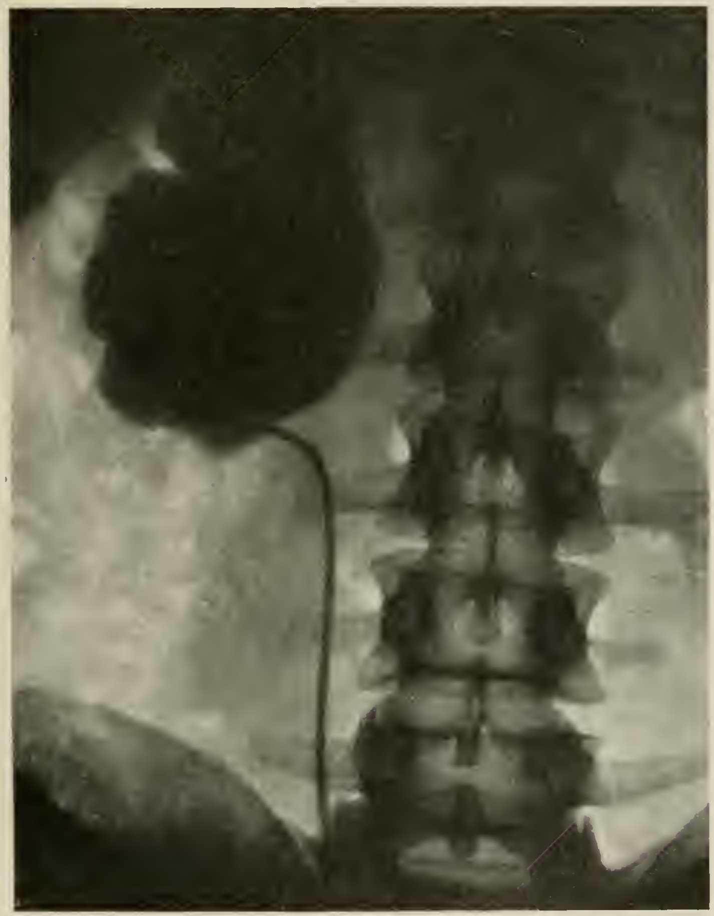

Fig. 1. Case 1. Large Left Hydronephrosis Due to Kinked Ureter

In this case operation was advised after the estimate of the renal function of each kidney, and depending upon those bindings to consist in nephrectomy or freeing of the ureter and possibly some plastic operation on the renal pelvis.

Case 2. N. E. Forty-two years old, married, foreman.

Complaint. Attacks of pain in the right loin for the last five years. At times there have been from three to six months interval between them. The last attack, ten days ago, was severe and was associated with nausea. The pain does not radiate. The attacks last from several hours to a couple of days, leaving a soreness in the loin after they have passed off. There are no urinary symptoms. Patient has been told that he had gall stones. Of late there have been some chilly sensations and night sweats.

Examination. Well developed and nourished man. Chest, abdomen, genitals, and extremities negative. Urine clear, no albumin, no sugar, no sediment.

Cystoscopy. Normal bladder and ureteric orifices. Right side catheterized without obstruction to the pelvis of the kidney. Rapid, but a seemingly ureteric flow of clear urine, which showed on examination an occasional red blood corpuscle only. A clear efflux from the left ureter. The right kidney pelvis was injected with sodium bromide solution 15 cc. without causing pain. X-ray report: Right kidney very low. Shadow of injected pelvis extends below the crest of the ilium. Pelvis large and apparently distended. Calices dilated and have lost much of their normal cupping. Injected ureter is extremely tortuous and has a sharp turn near the level of the lower portion of the sacro iliac joint. A second, and much sharper kink just below the entrance of the ureter into the kidney pelvis. In the region of the extreme lower calyx is a small dense shadow overlying the shadow of the ilium which is visible in both the injected and partially injected plates. In the completely injected plates there is a spot of increased density within the injected area which is suggestive of a small stone in the lower calyx.

Operation was advised in this case, to consist of freeing the ureter, with fixation and suspension of the kidney and straightening out of the ureter. The small shadow seen in the lower pole of the kidney may be a calculus, but certainly has no bearing on the case as far as producing symptoms is concerned. The injected ureter is very suggestive of a kink, due to the presence of an abnormal renal vessel.

Case 3. H. M. Thirty-eight years old, married, carpenter. This patient was referred to the hospital from the Out-Patient Department for an examination of the genito-urinary tract for pain in the left back and loin. As he had worked much as a painter it was thought he might have lead poisoning. No evidence of this, however, was found.

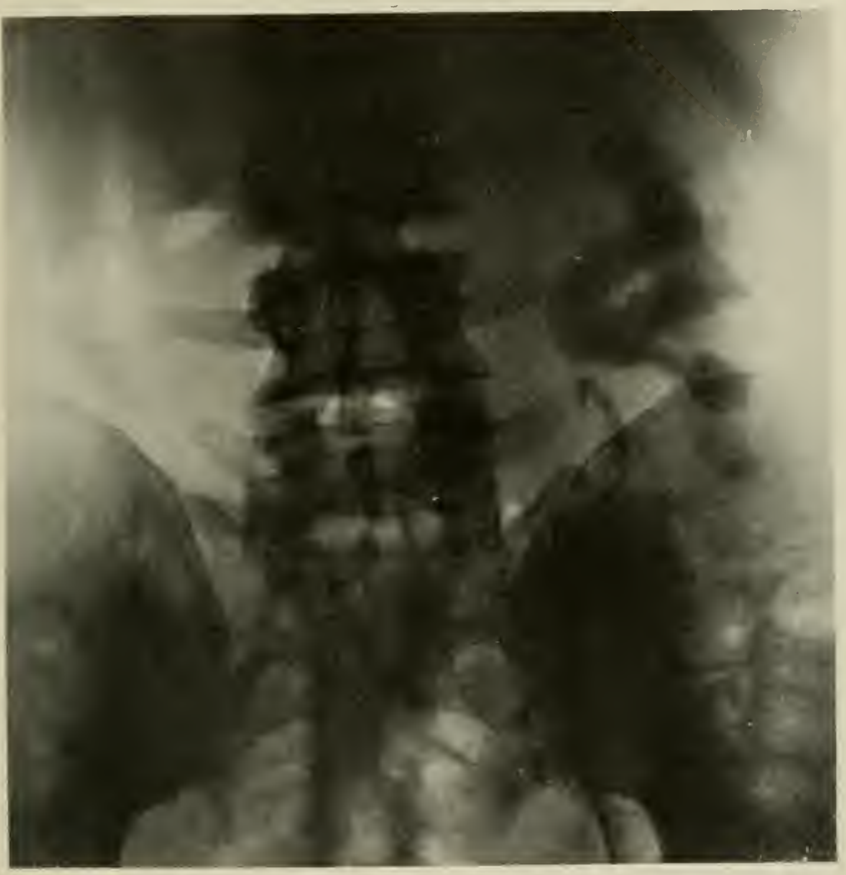

FIG. 2. CASE 2. RIGHT HYDRONEPHROSIS DUE TO KINKED URETER

Right renal pelvis suggestive of abnormal renal vessel. Second kink lower down the ureter.

Complaint. Pain in the left loin, below the ribs for the last fifteen months. Five years previous had a similar attack sufficiently severe to make him stop work. The first attack came on suddenly and was localized in the loin. The later attacks radiated to the groin on that side. At first the attacks came about every five weeks, lasted about three days and disappeared. At the time of the attacks the side was sore and tender to the touch. Of late they have been coming about once a week. They are not associated with vomiting and there have never been any urinary symptoms. He has lost 15 pounds in weight.

A note at time of entrance states, pain seems to be of renal origin, but strange, without any urinary symptoms. X-ray negative, urine clear and sparkling, No albumin, no sugar, no sediment.

Examination. Rather thin man. Chest, abdomen extremities negative.

Cystoscopy. Bladder normal except for slight chronic cystitis. Right ureter catheterized to pelvis without obstruction. Catheter in left ureter stops about two inches short of the kidney. Normal rapid flow of clear urine from the left. Steady flow of clear urine from the right. Sediments: A few red blood cells only from each kidney. Renal function, 1 cc. phenolsulphonephthalein, appearance time two and one-half minutes from the right kidney, 50 per cent excreted in fifteen minutes. No function from the left. Cultures from the left kidney and bladder sterile. Pyelogram: Right kidney pelvis normal in shape, but considerably larger than usual. In the left kidney areas there are some irregular shadows suggestive of hydronephrosis. There is apparently a kink, or stricture, of the ureter at its upper end which prevents the entrance of the catheter into the renal pelvis.

Deductions. Left hydronephrosis due to kink or stricture of the ureter with probable destruction of the kidney. Total renal function. Appearance time twelve minutes. First hour 15 per cent. Second hour 15 per cent. Operation advised.

February 2, 1922, operation, Dr. R. F. O'Neil. Gas oxygen-ether, anesthesia. Left oblique loin incision. Left kidney was delivered. Found to be enlarged. Looked and felt like a good secreting organ. Renal pelvis was considerably dilated and the ureter was found adherent to the pelvis, definitely kinked, the first portion running upward after its emerging from the renal pelvis, this portion being firmly adherent to the pelvis. The ureter was freed by dissection and straightened and the kidney suspended, the idea of nephrectomy being abandoned because of the normal look and feel of the organ, in spite of the misleading functional finding. Convalescence was uneventful. Diagnosis: Bilateral hydronephrosis. Moderate degree on the right, extensive on the left with obstruction due to kinked ureter.

Pyelogram taken seven weeks after operation shows a markedly dilated kidney pelvis, calices are normal and show normal cupping, and the ureter apparently coming from the pelvis in a straight line.

Cystoscopy done at this time shows a slightly injected bladder, both sides catheterized easily. Free flow of clear urine from the left kidney; 77 cc. obtained. Renal function, appearance time, right kidney four minutes, 20 per cent excreted in fifteen minutes. Left side appearance six minutes, 15 per cent excreted in fifteen minutes.

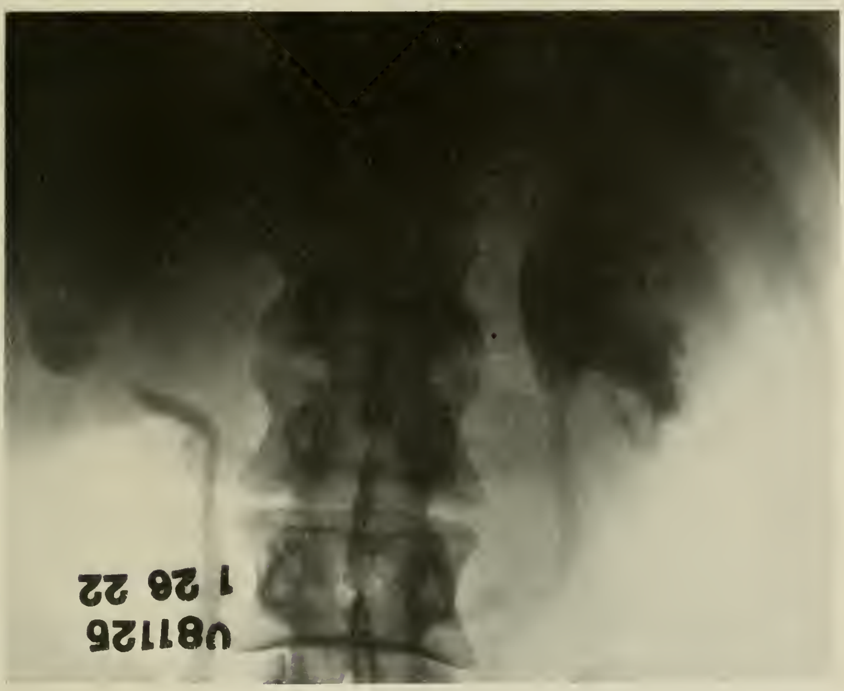

Fig. 3. Case 3. Bilateral Hydronephrosis
Kinked ureter on the left

After this second cystoscopy a slight infection of the kidney took place, evidenced by a cloudy urine and some tenderness at the left costa vertebral angle, but no pain. There was slight frequency of micturition. This condition, however, has gradually improved and there have been no attacks of pain in the left loin such as occurred previously to operation.

Cases 1 and 2 of this series were seen at the Consultation Clinic at the Massachusetts General Hospital. In this clinic, patients of moderate means are referred by their physicians for diagnosis and are afterwards referred back to them, so that I am unable from personal observation to give the end results in these cases. The following quotation from a letter received from the physician in charge of case 1.

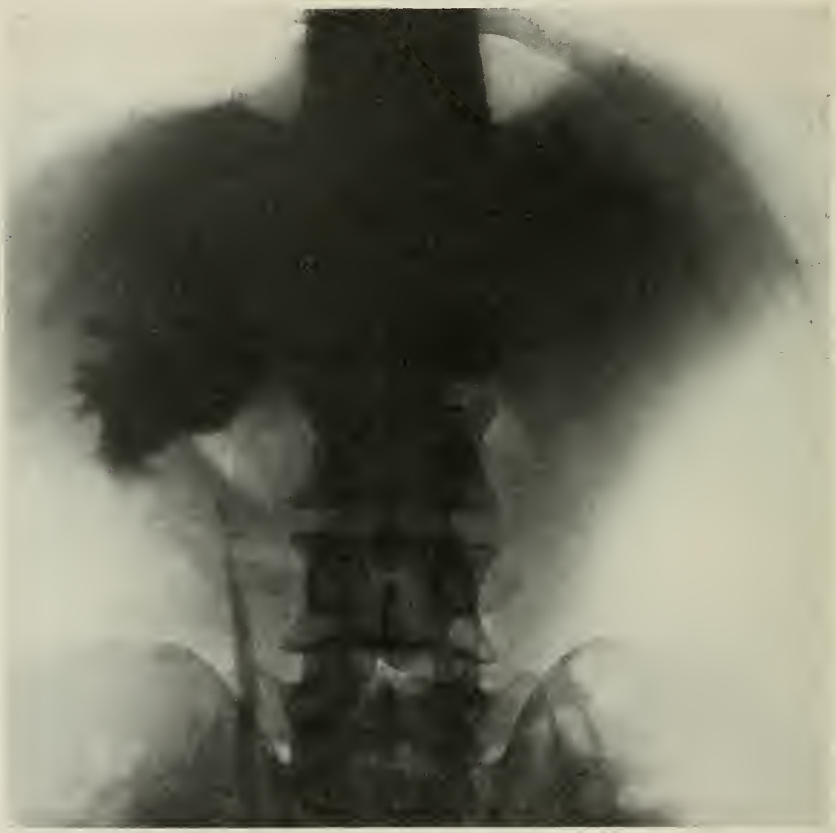

Fig. 4. Case 3. Showing Case After Operation of Freeing Ureter

Left hydronephrosis but ureter apparently is coming from the pelvis of the kidney in a straight line.

Patient was operated on and a large hydronephrotic kidney removed. The stricture was just at the beginning of the ureter, but owing to the great destruction of the kidney substance and the immense size of the pelvis of the kidney, I did not think there was any use of trying any plastic work on the stricture. The patient made a good recovery, left the hospital in twelve days, and has been completely relieved of his attacks which were continuous up to the time he was operated upon.

Case 2 has not been heard from. These cases are reported for their interest from a diagnostic viewpoint.

GONOCOCCAL INFECTIONS OF THE KIDNEY[1]

J. DELLINGER BARNEY
Boston, Massachusetts

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After reading the very complete article of the same title by Simmons (1) published as recently as last February, one feels as if nothing further could be added to the subject. His careful review of the literature, discussion of the routes of invasion of various organs by the gonococcus and his admirable bibliography are most valuale contributions.

It will be noted, however, that the cases reported in the literature, even when undoubted examples of infection by the gonococcus, are singularly free from any adequate description of the cystoscopic findings or of the pathology of the kidney when an operation was performed. I agree with Buerger (2) that such descriptions are lacking and that they should be made available when possible, so that the urologist may have a "well defined picture of what he is to expect when he examines the bladder in which gonorrheal invasion plays the most prominent part."

As Simmons' article does not include one additional case of gonococcal infection which has been reported, and as a case which came under my own observation is complete in all respects, including a most careful pathological examination, it has seemed worth while to call attention to these instances of the lesion under consideration.

Lehr (3) reported such a case in a man of thirty-four. There had been an attack of gonorrhea in 1903, with a second attack in 1905. There were no symptoms from then until 1911 when gonococci were found in the urethral discharge. As the urine was persistently cloudy, containing pus and gonococci, and as terminal hematuria subsequently developed, cystoscopy was done and the ureters catheterized. The bladder mucosa was uniformly red and inflamed but the ureters were "normal." Purulent urine, containing gonococci in pure culture was obtained from the left kidney. Treatment consisting of vaccines, and renal lavage with argyrol and silver nitrate, was continued for two or three months at the end of which time the left kidney urine was clear and free from organisms.

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[1] Read at the meeting of the American Association of Genito-Urinary Surgeons, Washington, May, 1922.

The following case occurred in my own practice.

V. D., male twenty-three, white, merchant marine. Admitted to the United States Marine Hospital, Chelsea, Massachusetts, April 23, 1921.

Family history. Unimportant.

Past history. Tonsillectomy and adenoidectomy in childhood. Left herniotomy in 1919.

Up to one year ago had had frequent headaches with blurring of vision. Loss of appetite for the past three months with loss of weight. No cough, dyspnea, pain in chest or night sweats. No urinary symptoms. No edema. Denies lues. Gonorrhea in April, 1920, with no complications.

Present illness. Recently acquired second attack of gonorrhea with epididymitis.

Physical examination. Well developed, poorly nourished, shows evident loss of weight.

Head, throat, chest, abdomen and extremities show nothing abnormal.

Purulent urethral discharge. Left epididymitis in an acute stage.

Smear of urethral pus shows gonococci.

Urine, twenty-four-hour amount 3000 cc. Specific gravity, 1.015; albumin; slightest possible trace; no sugar. Sediment shows an occasional red blood cell and epithelial cell, an occasional hyaline, epithelial, granular and pus-cast, together with much pus. Repeated examinations of the twenty-four hour urine were essentially as above.

Blood pressure, 144 systolic, diastolic 76.

Blood Wassermann negative.

Blood smear not abnormal.

April 25, 1921. Left epididymotomy with good recovery.

During the next few weeks patient had several attacks of severe pain in the back, lasting from five to twenty minutes, sometimes accompanied by nausea and vomiting and producing more or less collapse.

Patient referred to me on June 18, 1921. He then stated that the abdominal pain above described had begun after his first attack of gonorrhea and previous to the second attack. The pain had been of short duration coming in severe paroxysmal attacks.

Owing to the high blood pressure, casts in the urine and loss of weight patient was thought to have nephritis, but I could not confirm this view.

Examination at this time showed a slight purulent urethral discharge, moderate induration of the left scrotum as a result of operation, a cloudy urine, and slight left costo-vertebral tenderness. Abdominal examination showed no masses or tenderness and neither kidney could be felt.

Cystoscopy on June 21 showed redness and edema involving the orifice of the left ureter and the mucosa in its vicinity, the appearances strongly suggesting a tuberculous lesion. Elsewhere the bladder was normal. Catheters passed easily to each kidney with a normal ureteric flow from each side, the amounts being about equal (a point of importance in view of the subsequent findings).

The right urine showed a few leucocytes, the left urine showed many gram negative, intracellular diplococci. Phenolsulphonephthalein (intravenous) appeared on the right side in three minutes, on the left side in two minutes (!) with 20 per cent on the right and less than 10 per cent on the left in fifteen minutes. Pyelogram on the left side showed a considerably enlarged pelvis, deformed, flattened calices and no kidney shadow. There was no evidence of stone (fig. 1).

In view of the reported presence of gonococci in the left kidney urine the bladder urine was subsequently examined on several occasions, pus and Gram-negative diplococci being constantly found. Meantime the patient ran no temperature; attacks of abdominal pain and left costo-vertebral tenderness continued as before.

Another cystoscopy was done on July 1 by Dr. Oscar F. Cox at United States Public Health Hospital No. 36, Boston, and this examination confirmed and repeated in almost every detail the findings of the first examination.

Operation was performed by me on July 7, 1921, nephrectomy being done under ether. At first no left kidney could be found but it was soon discovered lying against the posterior abdominal wall. The kidney was about the size of a pullet's egg with a much dilated, thin pelvis. The ureter was normal.

Convalescence was uneventful and the patient was discharged on the fourteenth day to continue the treatment of his gonorrhea as an out patient.

The specimen was submitted to Prof. S. B. Wolbach of the Harvard Medical School, who took great interest in the case and to whom I am deeply grateful for the following detailed report of his examination.

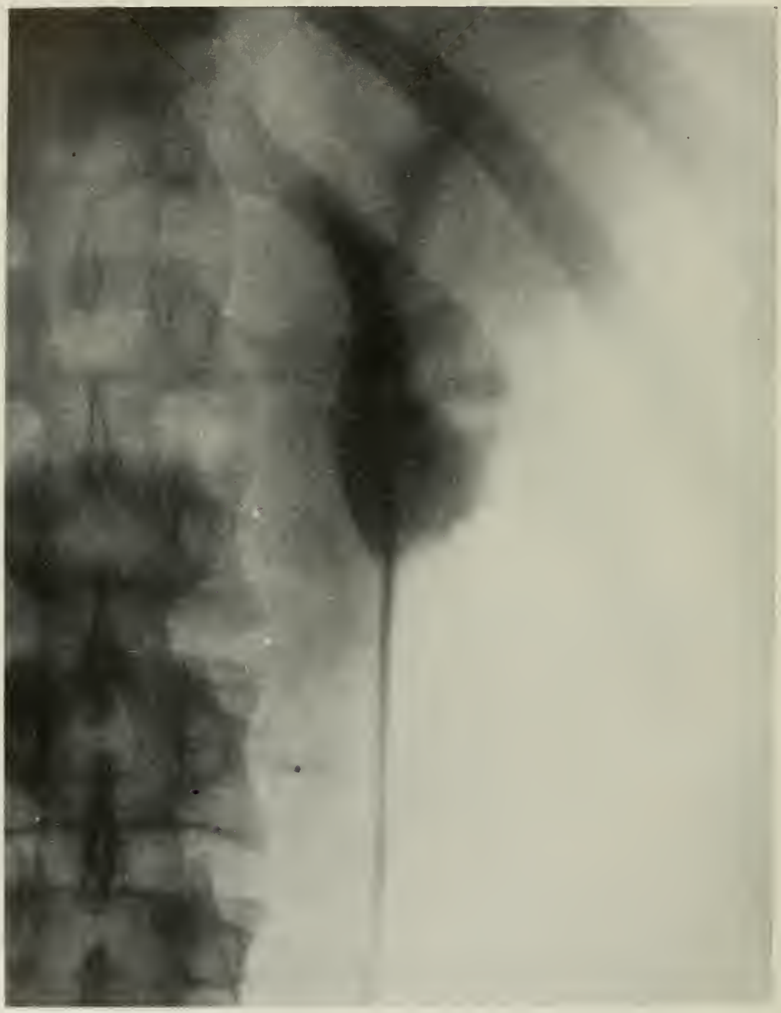

FIG. 1. PYELOGRAM OF APLASTIC KIDNEY WITH GONOCOCCAL PYELITIS

Calices rudimentary and clubbed, pelvis somewhat dilated, no evidence of kidney shadow.

Gross description: The specimen consists of a kidney which has been opened along its convex border and about 4 cm. of ureter. The whole weighs 35 grams. The kidney is 7 cm. long by 3.5 cm. wide and 2 cm. thick. The outer surface is nodular with a distinctly thickened capsule. The cut surfaces show a dense light yellowish brown tissue of increased density, the dilated calices surrounded by narrow zones of fibrosis. Thus far the kidney resembles any similarly shrunken kidney. The mucosa of the calices and pelvis is striking in that it is lined with transparent, miliary sized elevations, evidently granulation tissue from which a thin, puriform material can be scraped (fig. 2).

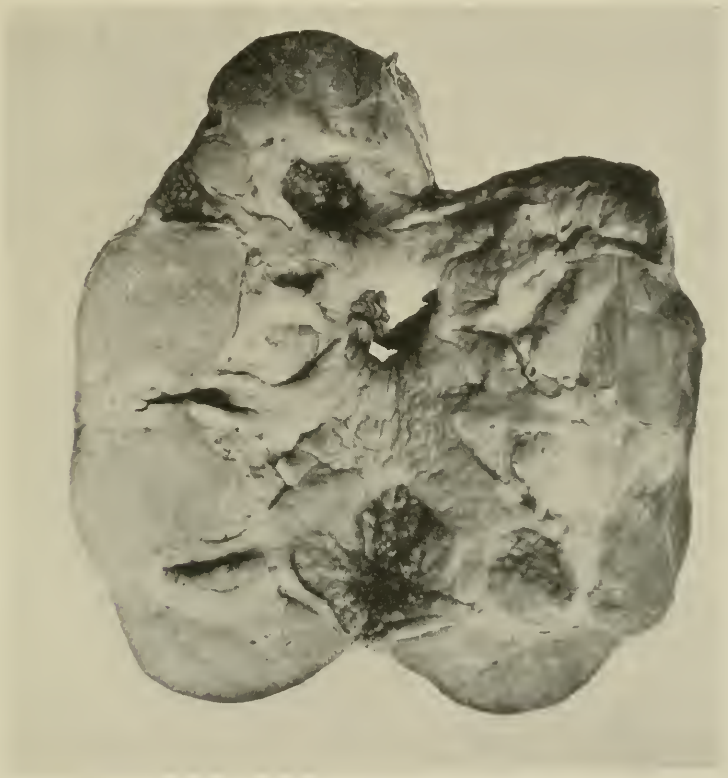

Fig. 2. Interior of Kidney Showing Lesions of Pelvis as a Result of Gonococcal Infection

Microscopic examination of the material from the pelvis of the kidney shows exclusively in small numbers gram negative, flattened diplococci within polynuclear leucocytes.

Cultures were made on two plates of blood agar.

Portions of kidney, ureter, pelvis and dilated calices are fixed in Zenker for microscopic examination.

Bacteriological note: Cultures are positive for gonococci.

Microscopic report: Sections through the ureter and pelvis of the kidney show intact epithelium. The elevations noted in the gross specimen are due to collections of lymphoid cells immediately beneath the epithelium. These collections of lymphoid cells contain numerous capillaries and vessels of pre-capillary size. There are many large lymphocytes, some of them in mitosis. An occasional one presents a center of large cells giving the appearance of a lymphoid follicle. The lesion is very similar to that of the conjunctiva in trachoma. The epithelium covering these follicles is thinned in some places to a layer two to three deep of flattened epithelial cells. There are also occasional polymorphonuclear leucocptes in and upon the surface of the epithelium. Deeper in the submucosa are small collections of lymphoid and plasma cells, while in some of the collecting tubules are numerous polymorphonuclear leucocytes. An occasional eosinophile is found in the diffuse infiltration in the submucosa and about the collecting tubules. The histology of the mucosa and the ureter is identical to that of the pelvis of the kidney. The kidney tissue selected for study shows some radial cicatrices extending from the pelvis with intervening renal tissue essentially normal in appearance. There are perfectly normal glomeruli and tubules. A very rare diplococcus is found in leucocytes in cross sections of collecting tubules close to the pelvis.

The outstanding feature of the pathology of this kidney is the production of lymphoid follicles beneath an intact epithelium of the pelvis and ureter. There is also a moderate diffuse infiltration with lymphoid, plasma cells and eosinophiles in the tips of the pyramids. The only puriform exudate is to be found in the recesses of the pelvis and in collecting tubules.

Additional bacteriological note: The cultures made upon blood agar yielded colonies of gram negative, flattened diplococci which coincide in every way with gonococcus in their growth requirements. They were cultivated upon blood agar. They would not grow upon ordinary media.

From the appearance of the kidney and from the histology it seems more probable that this is a congenital aplastic kidney rather than the result of a post natal pathological process.

Diagnosis. Gonorrheal pyelitis; aplastic kidney.

Aside from the interesting and unusual nature of the infection of this kidney and the effects produced in the pelvis by the infecting organism, its aplastic condition is worthy of notice. Although such kidneys are uncommon they occur with sufficient frequency to warrant being borne in mind. Like all underdeveloped and abnormal organs they are far more likely than is the normal organ to become infected or otherwise diseased. But even when free from an acquired pathology the small amount of urine obtained from such a kidney, together with its low phthalein output, even though such findings are coupled with an otherwise normal urine, should arouse suspicion of the presence of such an organ. The pyelogram may or may not be of value for the reason that the renal pelvis itself may be within normal limits of size and shape. On the other hand the calices are apt to be small or rudimentary, and evidence of the shadow of the renal substance is generally lacking.

I take particular satisfaction in reporting this case because of the unusually complete pathological and bacteriological study. Of the 27 cases now recorded in the literature the infected kidney has been examined at operation or autopsy in only 4 or 5 instances and even in these cases adequate descriptions of the conditions are not at hand. It is also true that when operation has been done the kidney was extensively destroyed by a disease of long standing and there was also a mixed infection. My case is of value because of the presence of the gonococcus alone and also because this was of comparatively short duration, probably not more than a year, more probably only a few months.

The fact that so few gonococcus kidneys have come to operation would indicate that the infection is either so mild in its symptoms as to require little or no treatment, that it may be and generally is cured by palliative measures such as renal lavage, or that it may die out spontaneously. Operation, therefore, is done only in the presence of mixed infection, in which case some other organism than the gonococcus decides the issue, or in cases like my own where other factors such as hydronephrosis are responsible for the symptoms. It is therefore obvious that given an otherwise normal kidney the presence of gonococci in this kidney does not necessarily mean a bad prognosis. Collective experience would indicate that prompt, adequate, and sufficiently prolonged treatment will eventually clear up the infection. Renal lavage with either argyrol or nitrate of silver, hexamethylenamin and acid sodium phosphate in efficient dosage, and the ingestion of very large amounts of water appear to form the tripod upon which treatment must be based. It is also obvious that the infected prostate, urethra or other tissue must meantime receive appropriate attention.

REFERENCES

(1) Simmons: Jour. Urol., vii, 2.
(2) Buerger: N. Y. Med. Jour., December 14, 1918.
(3) Lehr: Jour. Amer. Med. Assoc., July 6, 1912.

THE TREATMENT OF PYELITIS[1]

C. H. CHETWOOD

New York City

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To undertake to answer the question—what is the treatment of pyelitis?—is like attempting to name the treatment of cystitis. The answer in either case would resolve itself into an investigation of etiology and bacteriology. There is, however, no intention on the part of the speaker to inflict upon this seasoned assembly such unnecessary detail. The purpose is rather to speak of a single method of treatment, to report the experience therewith of those who have contributed to the subject, to give the result of a limited personal observation and to defer pending more extended observation, a qualified judgment as to its relative value.

I refer to the method introduced by Gross of Vienna involving the treatment of pyelitis by intravenous injections of neosalvarsan, with apparent strikingly successful effect. Naturally, the question arises as to what particular type of renal infection lends itself favorably to this procedure. Its value has been compared with the treatment by pelvic lavage of the same condition, the merits of which are variously estimated. The latter method has been used by some as a routine practice, often unjustified if not harmful, in any case, from one revealing a few leukocytes to that of a frankly purulent pyelitis. I garnered the opinion from some of the European clinics that lavage with the silver nitrate was applicable to colon bacillus pyelitis but not to streptococcus or staphylococcus. Be this as it may, it is interesting to note the experience of different observers with the treatment by intravenous injection of neosalvarsan.

It is stated that Porges (Necker (1)), first observed the clearing up of a urinary infection after the injection of neosalvarsan. The case was one of cystitis and pyelitis in a tabetic patient. The bacterial coefficient in this instance is not stated but according to the same observer the treatment is without effect in gonorrheal cases.

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[1] Read at the meeting of the American Association of Genito-Urinary Surgeons, Washington, May, 1922.

A brief abstract of what may be gleaned from the literature is as follows: The "rationale" of the controlling influence upon bacterial invasion of the renal pelvis by intravenous injections of neosalvarsan is kindred to that of hexamethylenatetramin although *intravenous injections* of the latter do not exercise the same effect. Old salvarsan does not work. The therapeutic effect is not sufficiently explained athough it is thought in some way to be due to the spliting off of formaldehyde in the blood. Gross' theory assumed that the freeing of the formaldehyde took place in the kidney itself and his tests proved the presence of formaldehyde in the urine. Favorable results are reported in both acute and chronic cases, although in the former group the urine does not clear so quickly as in the latter.

Kall of Freiburg (2) who is attached to Professor Rost's Genito Urinary clinic, has used this method of treating pyelitis for three years. Most of the cases were post-gonorrheal but did not reveal a gonococcus infection of the pelvis. The organisms comprised B. coli and staphylococcus. The author contrasts this treatment favorably with older methods especially that of urotropin, as the former is not dependent for its success upon an acid medium. The results obtained were favorable in a high percentage of cases. In a few cases relapses occurred but improved upon return to treatment. A small percentage proved refractory to this method.

Necker (1) reports observations covering a four years' period. In summarizing his observation he states that neosalvarsan injections show beneficial effect in all cases where inflammation is limited to the mucosa of the renal pelvis and fail where the parenchyma of the kidney is notably affected. The effect is also checked if there is retention of urine either in the pelvis or the bladder.

Nathan and Reinecke reported extraordinarily favorable results and tested the remedy especially in pyelitis complicating female gonorrhea (non-gonococcus infection). Of especial interest is this treatment in the case of solitary kidney of the nephrectomized patient.

Rencker of Herzheimer's Dermatological Clinic, Frankfurt am M. (3) embodies in his report those of Gross, Nathan and Reinecke, and Kall. He furnishes the history of 12 personal cases. Most of these were former gonorrheal subjects who had had inadequate treatment. Save for 1 case the results bore out the claims of Gross and other authors reported. There was no recurrence.

The technic is the usual method employed, namely, freshly prepared solution in recently boiled and distilled water. The average dose is 0.15 gram of the drug. Subsequent dosage according to effect and response, as low as 0.05 gram and up to 0.3 gram. Total number of doses usually four. Intervals from three to five days.

As to personal experience, I employ a 5-cc. record syringe with an unusually fine platinum, iridium needle and dissolve the dose of neosalvarsan, whether it be the minimum or maximum quantity, in that amount of water.

Case 1. November, 1921; female; age twenty-three. General health, good. Frequency of urination commenced two years ago when B. coli bacilluria was detected. Present condition: urination every two hours, day and night, painful at times but not always. Cystoscopic examination reveals general cystitis of mild degree.

Both ureters catheterized.

Right side specimen: Frequent pus cells; caudate and cuboidal epithelial cells; scattered red blood cells; microörganisms, many bacilli in chains; negative for tuberculosis.

Left side specimen: Frequent pus cells; caudate and cuboidal epithelial cells; many red blood cells; microörganisms, bacilli in chains and cocci; negative for tuberculosis.

Cultures from throat and left kidney urine yield Staphylococcus aureus and albus. Autogenous vaccine from culture administered without improvement. First intravenous injection, neosalvarsan 0.15 gram in 5 cc. distilled water. Second injection three days later. Soon afterwards blood appeared in the urine and when this subsided some improvement followed, revealed in elongation of urinary intervals from two to four hours and some clearing up of the urine. One week after second injection a third was given of 0.1 gram. Six days after the third a fourth dose of 0.15 gram was given.

The improvement in this case was maintained for three weeks after stopping injections, then a relapsing tendency was revealed which quickly yielded to renewed treatment in a much milder dosage. At present report, three days after last treatment, intervals are about one-half as frequent as formerly and the urine in gross appearance is notably clearer. The right catheterized specimen is normally clear and the left only moderately turbid.

Case 2. March, 1922; male; aged nineteen. No venereal history. Two years ago entered hospital for alleged appendicitis. No operation. At that time blood and pus found in the urine and since then dysuria with increasing intensity. At present urination every one and one-half to two hours, day and night, with much pain before and during urination. The urine is freely purulent. Capacity of bladder reduced to between 3 and 4 ounces. Cystoscopy: marked cystitis in vicinity of trigone rendering it difficult to detect ureteral openings. Both ureters are catheterized. Right side specimen diffusely turbid; numerous pus cells, pelvic cells. Left side normal specimen of clear urine obtained. First treatment, 0.15 grams neosalvarsan injected intravenously, following which within twenty-four hours there is abatement of symptoms. Second treatment, seven days later, 0.15 grams neosalvarsan. Following second treatment, for the first time in many months patient passes the night through without the necessity of rising but once to urinate. The urine is somewhat clearer but still cloudy and purulent. Third treatment, seven days after second, same dosage.

Last report now about two weeks after third dose: bladder capacity increased to 7 ounces. Urine much clearer. Pain entirely absent Intervals about every four hours. General health noticeably improved.

This communication is only a brief note and not a paper as it purports to be. But the subject seemed to me to be of sufficient moment to become a part of these proceedings and I hope you agree with me.

REFERENCES

(1) Necker: Rothschildspital reports, Vienna, vi, Nr. 1–2, 1921.
(2) Kall: Munch. Med. Woch., May, 1920.
(3) Rencker: Archiv. f. Dermatol. u. Syph., 1921.

ACQUIRED STRICTURE OF THE MALE URETER[1]

ROBERT H. HERBST AND ALVIN THOMPSON

Chicago

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In 1918 we reported a method of treating strictures of the lower end of the ureter and called attention to the rôle played by infected seminal vesicles in the production of strictures in this location. Strictures of such etiology or the possibility of such an origin are scarcely ever mentioned in the literature. Most of the monographs and works on stricture of the ureter deal chiefly with strictures which are congenital, tuberculous, accompanying or following stone or due to focal infection.

Voelker (1) in his monograph on diseases of the seminal vesicles refers to extension of infection to the ureteral wall from the seminal vesicle and states that when this occurs the symptoms are those of renal obstruction. Geisinger (2) in reporting a case of ureteritis with thickening and stricture due to extension from an appendicitis, recognizes the possibility of such lesions occurring by contiguity from adjacent tissues. Morgan (3) McNeil (4) and Frank (5) have respectively reported cases of ureteral strictures resulting from extension of infection from seminal vesicles, pelvic abscess and uterine appendages.

The term male ureter is used in the title because we wish to discuss only strictures which involve the lower end of the ureter, viz. that portion which is closely neighbored by the lower part of the genital tract in the male. The seminal vesicles and at times the prostate gland harbor infections which spread to the ureter producing occlusion and later stricture. Obstructions of this type are often unrecognized due to the fact that the symptoms are frequently overshadowed by those of the genital tract and they are not discovered until the patient is subjected to a careful cystoscopic and roentgenological examination.

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[1] Read before the American Urological Association, Atlantic City, April, 1922.

In many cases the pain in the back is so localized and of such a character that it is logically supposed to be due to the vesiculitis. It is only after the inflammation and swelling of the vesicle have been relieved without proportionately influencing the pain and pyuria that a lesion of the ureter or kidney pelvis is suspected.

These strictures are usually found in early and middle adult life, the period when infections of the prostate gland and seminal vesicles are most common. The organisms which are the primary etiological factors in these occlusions are the bacteria which commonly cause infection in the genital tract i.e. the gonococcus, colon bacillus, etc. However, by the time the process has spread to the wall of the ureter the gonococcus is difficult or impossible to demonstrate in the secretions of these glands.

Pathology. The term occlusion rather than stricture describes the changes which occur in the ureteral wall because many do not progress to the connective tissue stage. Pathologically there are three degrees of obstruction.

1. Congestion, in which there is swelling often accompanied by edema and usually associated with acute prostatitis and seminal vesiculitis.

2. Inflammatory type, in which there is an infiltration of the ureteral wall which may be present as such for some time without going on to connective tissue proliferation.

3. Fibrous stricture, which follows the inflammatory type and for which the chlorides of the urine are largely responsible.

Strictures of the ureter develop very much like strictures of the urethra, only there is rather a reverse order of things. In the development of urethral strictures the mucous membrane is first involved, the inflammatory process destroying the superficial epithelium which might well be termed the rubber coat of the urethra. This is followed by infiltration of urine, the chloride constituents of which produce connective tissue proliferation. In ureteral strictures which develop secondary to infections of the seminal vesicles the inflammatory process spreads to the ureteral wall producing the inflammatory type of obstruction in some instances followed by the fibrous type due to infiltration of urine into the inflamed area. The gradual contraction of the stricture is followed by dilatation of the ureter and the pelvis of the kidney.

Symptoms. The early symptoms are often those found in prostatitis and seminal vesiculitis; this is particularly true in the inflammatory stage before marked renal obstruction has developed. The patient complains of frequent imperative urination with pain at the end of the act and the urine is crowded with pus and shreds. The pain radiating up along the course of the ureter and into the flank in acute prostatitis may be due to a coincidental swelling of the lower ureteral wall with occlusion, the pain usually subsiding with the decline of the inflammation in the prostate gland. Mark (6) has reported two cases of complete acute renal retention secondary to infection of the seminal vesicles. Complete retention is remarkably rare. Mark (6) admits that in at least one of the cases there was not a complete occlusion due to stricture, but due to acute edema analogous to that which frequently occurs in the urethra resulting in acute vesical retention. The later symptoms are the symptoms produced by renal retention, the severity of which depends upon the degree of obstruction caused by the stricture.

Pain which is probably the most common symptom may vary from a dull ache in the lower pelvis which may or may not radiate up along the course of the ureter, to a severe renal colic. Intermittent attacks of renal colic occur and are due to acute renal retention caused by the same conditions which produce bladder retention in stricture of the urethra. Temperature which may be continuous or intermittent usually takes the curve of a pyelitis and is indicative of infection of the renal pelvis.

Blood may be found in the urine as an early sign and may come from the ureteral wall in the inflammatory stage, however, it is usually found later when destructive changes have occurred in the kidney.

Pus is usually found in the urine, its origin being difficult to determine as it may come from the upper urinary tract, the lower genital tract or both. The colon bacillus is the organism most commonly found even in the cases in which the primary infection in the seminal vesicles is caused by other bacteria such as the gonococcus.

Diagnosis. The importance of free drainage from the kidneys cannot be overestimated and when obstruction of the ureter occurs the earlier it is discovered and relieved the better the chance for avoiding impairment of renal function. Many of these patients have had a prolonged infection of the prostate gland and seminal vesicles, the symptoms of which have masked the gradual development of the stricture.

The pain produced by ureteral obstruction is often attributed to the prostatitis and the process is far advanced before the obstruction in the upper urinary tract is suspected. The diagnosis of these strictures by means of the olive tipped bougie, the wax bulbed catheter is incomplete and often fallacious. The so-called "hang" noticed on withdrawing the bulbed catheter or bougie is fairly reliable when felt in the female through the Kelly cystoscope, because in the Kelly method the friction of the instrument is negligible but in the male where a longer cystoscope is used with a narrow catheter channel the resistence of the instrument makes this delicate manouver at times unreliable. For this reason we agree with Braasch (7) that even if a stricture is diagnosed by the waxed tipped catheter, a uretero-pyelogram is the most valuable and reliable method as it not only shows the location of the stricture but also reveals the extent and degree of ureteral and pelvic dilatation.

A valuable sign in the diagnosis of these strictures is the absence of peristalsis in the mural portion of the ureter as seen through the cystoscope. The peristalic wave may be entirely absent or not as active as compared with the uninvolved side. This is evidently due to a thickening and rigidity of the extreme lower end of the ureter and surrounding bladder wall. It is striking to observe the difference in the appearance of the meatus and the area of the bladder wall just above it, as the urine is expelled.

Treatment. Early relief of obstruction caused by stricture of the ureter is essential if we may hope to preserve the function of the kidney. In the early inflammatory type where the condition in the ureter is merely a reflection of the infection in the seminal vesicle, treatment directed to the infected vesicle and prostate will sometimes be followed by subsidence of the occlusion in the ureter. The renal symptoms may entirely disappear following routine massage, vasotomy or vesiculotomy.

Belfield (1909) (8) in discussing the treatment of seminal vesiculitis states that renal pain, "lumbago," or "nephralgia" often occurs when the vesicle is distended and is promptly relieved by emptying the vesicle either through massage or vasotomy.

In the indurated type gradual dilatation with ureteral bougies is indicated. These strictures respond quite readily to this form of treatment. A graduated bougie is used introducing it one or two cm. further at each treatment until it is stretched beyond the normal size. Treatment should also be directed to the diseased seminal vesicle and the patient should be observed for some time to prevent recurrence. Ureteral like urethral strictures have a tendency to recur. This may be prevented by continuing to pass bougies at long intervals after full dilatation has been reached.

The hard fibrous type which fails to respond to dilatation and which is limited to the mural portion of the ureter may be cut by introducing a hook shaped knife into the lumen and incising the involved area by the withdrawal of the knife. The instrument which was described by one of us (Herbst) may be used either through an operating cystoscope or through the opened bladder. The mural part of the ureter being 2½ cm. in length, this incision should not extent beyond 2 cm. from the meatus, in order to avoid cutting through the wall of the extramural portion of the ureter.

Strictures extending beyond the mural part of the ureter and which do not respond to dilatation should be excised and the end of the ureter reimplanted into the bladder. In strictures of long standing complicated by far advanced hydro- or pyonophrosis, nephrectomy may be indicated.

REFERENCES

(1) Voelker: Diseases of the Seminal Vesicles.
(2) Geisinger: Ann. Surg., 1917, v, 66, 654–663.
(3) Morgan: Ann. Surg., 1902, p. 528.
(4) McNeil: N. Y. Med. Jour., 1917, v, 56, 786.
(5) Frank: Interstate Med. Jour., 1917, v, 21, 209.
(6) Mark, E. G.: Reported at meeting Chicago Urol. Soc., December 1, 1921.
(7) Braasch, W. F.: Jour. Amer. Med. Assoc., 1919, v, 73, 731.
(8) Belfield, W, T.: Tr. Am. Urol. Assoc., 1909, v, 3, 13.

CONSERVATIVE RENAL SURGERY ASSOCIATED WITH URETERAL STRICTURE WORK[1]

GUY L. HUNNER

From the Gynecological Department of the Johns Hopkins University and Hospital

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The recognition of ureteral stricture as one of the most common of all intra-abdominal or intra-pelvic lesions will probably bear its chief fruit in the field of conservation by doing away with a vast number of abdominal and pelvic operations now being annually performed in the effort to relieve the symptoms, often vague and indefinite, associated with some form of this condition. Such recognition will also save much misguided medical effort, and should be particularly valuable in the urological field where we have been attacking many of our important problems from the wrong end.

Striking examples might be cited of patients, who, after years of general and special medical treatment for apparent migraine or other forms of sick headaches, have been promptly relieved by the restoration of free kidney drainage through the dilatation of ureteral strictures. Other patients suffering from chronic gastro-intestinal symptoms, such as nausea, vomiting, gas formation, diarrheal attacks, pressure on the rectum, and mucous colitis, that have defied all efforts at medical and surgical relief, have responded, some promptly, some after months of patient effort, but only after ureteral stricture has been found to be the basis of their symptoms and proper treatment instituted.

The orthopedist sees certain cases of apparent lumbo-sacral or sacro-iliac disease, of apparent hip-joint dysfunction, or of apparent sciatica, in which all his efforts at relief are fruitless.

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[1] Paper read before the nineteenth annual meeting of the American Urological Association, Atlantic City, New Jersey, April 26, 1922.

In some of these the symptoms are due to ureteral stricture and relief is obtained after suitable treatment.

What gynecologist has not failed to cure by operation a certain proportion of his patients who later haunt his office, or that of some confrère, in the attempt to be rid of the symptoms complained of before the operation? The gynecologist is daily dealing with vague indefinite backaches, bearing down sensations in the pelvis, ovarian neuralgia, and pains through the hips. He should be particularly alert for stricture if these symptoms are accompanied by bladder disturbances, especially if they are of the intermittent focal infection type. Dyspareunia (from impingement against the tender ureteral areas) is another suspicious symptom; and if all or most of these symptoms are present in the absence of a history of childbearing or of a definite pelvic inflammatory disease, he should investigate most carefully for the possibility of stricture.

The records of many of my ureteral strictures cases involving a history of from 1 to 9 abdominal operations in the effort to relieve the patient, but with the original symptoms still standing out prominantly, and then relieved after dilatation of the strictures, is sufficient evidence that the general surgeon can well afford to keep ureteral stricture in mind in his daily diagnostic routine.

As a group of urologists we should have a lively interest in any lesion of the urinary tract that may mean so much to the work of the internist and the surgeon, and that is of such vital concern to the patient.

With the limitation of time at my disposal today I can not enlarge upon the broader diagnostic aspects of this subject, and must confine myself to the meaning of ureteral stricture as it applies to the care of diseases occurring in the limited field of urology. Even such limitation leaves me with vastly more material than I can discuss in one paper and I shall be obliged to confine my detailed analysis of the possibilities of conservation inherent in ureteral stricture work to the one subject of hydronephrosis and its allied pathology of infections and malpositions.

If time and space permitted I could present numerous pyelo-ureterograms and case reports to demonstrate the value of ureteral stricture work in eliminating many of the operations formerly thought necessary. Among these are (*a*) nephrectomy on persistently painful kidneys in which the etiological factor could not be found because the plain non-bulb catheter failed to demonstrate an obstruction, (*b*) fixation or removal of painful hydronephrotic kidneys, (*c*) drainage by lumbar operation of large infected hydronephroses and pyonephroses, (*d*) partial removal of double kidneys, (*e*) nephrectomy or more conservative operations on kidneys bleeding without demonstrable cause, (*f*) abortions, or lumbar drainage of pyelitis in pregnancy, (*g*) repeated nephro-lithotomies, and (*h*) operations for supposed ureteral stones in which the symptoms were due to ureteral stricture, and in which the X-ray showed phleboliths or calcified glands.

In lecturing to students in former years on the subject of floating kidney and in an attempt to establish a classification as to the proper method of treatment, I used to summarize as follows:

> If your investigation by the kidney capacity test and by the pyelogram shows an approximately normal pelvis and particularly if the patient has a general visceroptosis, do not operate, but treat the patient with bandages, diet, and posture. If, on the other hand, your tests show a marked hydronephorisis, do not waste time with medical measures alone, but do a fixation and then take advantage of the medical helps.

I wonder if some of you may be still following a similar program. I am sure that those of you who have been in surgery long enough have found many disappointments in your attempts to relieve the symptoms of floating kidney by operation. I hope to show by the aid of roentgenograms some of the reasons for such disappointments.

Time limits a discussion of the many factors ascribed as the cause for abnormally movable kidney and in an audience of this type such a discussion would be superfluous. We must remember first that only a small percentage (Squier estimates it at 10 per cent) of floating kidneys are accompanied by a hydronephrosis. Again I wish to remind you that hydronephrosis of a marked degree may develop without causing symptoms, and without affording palpable signs of undue mobility. Ureteral stricture work has also demonstrated that a patient may be subject to repeated attacks simulating Dietl's crises, in which there is agonizing pain, accompanied by the general symptoms of nausea, vomiting, chills and fever, headache, and profound prostration, and in which urinalysis may show blood, albumin, and casts, and even an abundance of leukocytes, in the absence of an infection.

In many of these cases the pelvis capacity test and the pyelogram may show a pelvis of reduced capacity, and yet the ureterogram will show a slightly dilated ureter above the point of stricture narrowing, as contrasted with the narrow ureteral lumen below this point which usually shows nothing but the contained catheter without any surrounding radiogram fluid.

We shall first report 2 cases of pyelitis of pregnancy to demonstrate the harmless character of certain ureteral "kinks" which look formidable from the pyelogram view point, and then report several cases to show that the secondary effects of ureteral strictures in causing kinks and compressions in the kidney region may become most serious and call for operation.

Case 1 (see figs. 1, 2 and 3). Mrs. W., aged thirty years, referred by Dr. L. F. Barker in August, 1920. The patient complained chiefly of asthenia, headache, nausea, pain in the upper right flank and marked oliguria. She was two months' pregnant. At about fifteen years of age she had an attack supposed to be caused by a stone in the bladder, but after investigation this was diagnosed as "a uric acid shower." Two years later she had an attack of suppression of urine lasting for forty-eight hours with intense headache. At the age of twenty-three years, and while pregnant with the first child, she had pernicious vomiting and had to be fed by rectum for four months. With the best of medical attention she carried through to term. Two years later she again became pregnant and at the end of four months she could not retain the rectal feeding and went into a state of coma and lost her vision

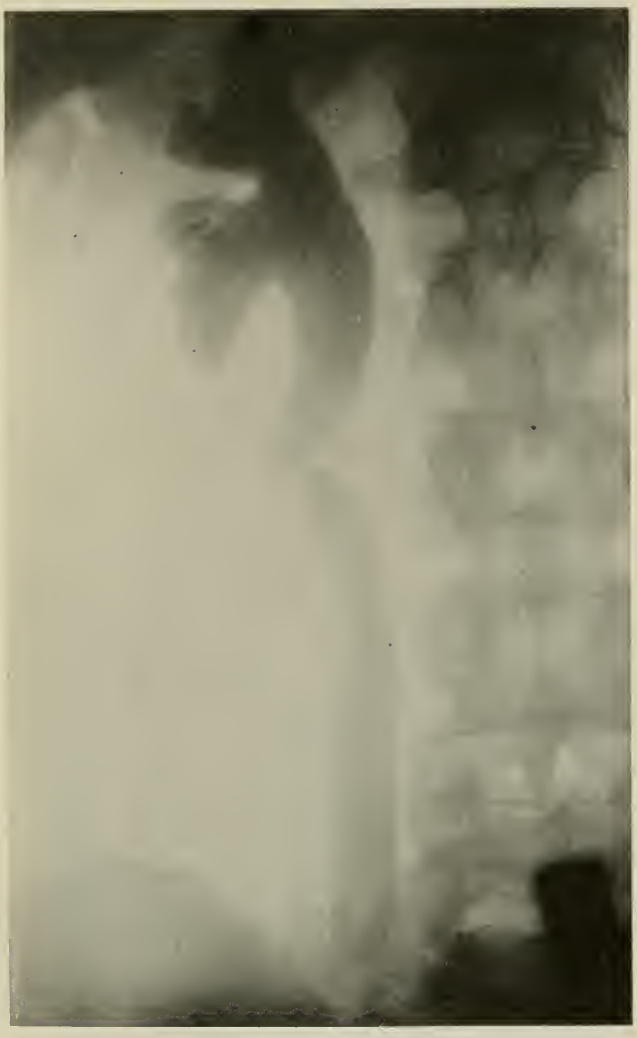

FIG. 1. ILLUSTRATING CASE 1; BILATERAL STRICTURE OF THE URETER, BILATERAL PYELITIS OF PREGNANCY

This plate shows moderately distended right kidney with proportionally greater distension of the ureter, the two holding 35 cc. Patient in prone position with exhalation. Note the apparent ureteral kink, but the ureter dilated just as much below the kink as above. Forced abortion of two months' pregnancy. Clearing of pyelitis and of symptoms after 10 dilatations on the right side, reaching 6 mm., and 9 dilatations on the left, reaching 5 mm., over a period of sixteen months. Shrinkage of right side from 35 cc. to 24 cc. content, of left side from 11 cc. to 8 cc. content. Right side showing better phthalein output than left.

for one week. An abortion was done. Five years ago she had Vincent's angina for two successive winters but this did not recur after the removal of infected tonsils and adenoids. This past spring she was to have some bad teeth extracted and in preparation for the anesthetic it

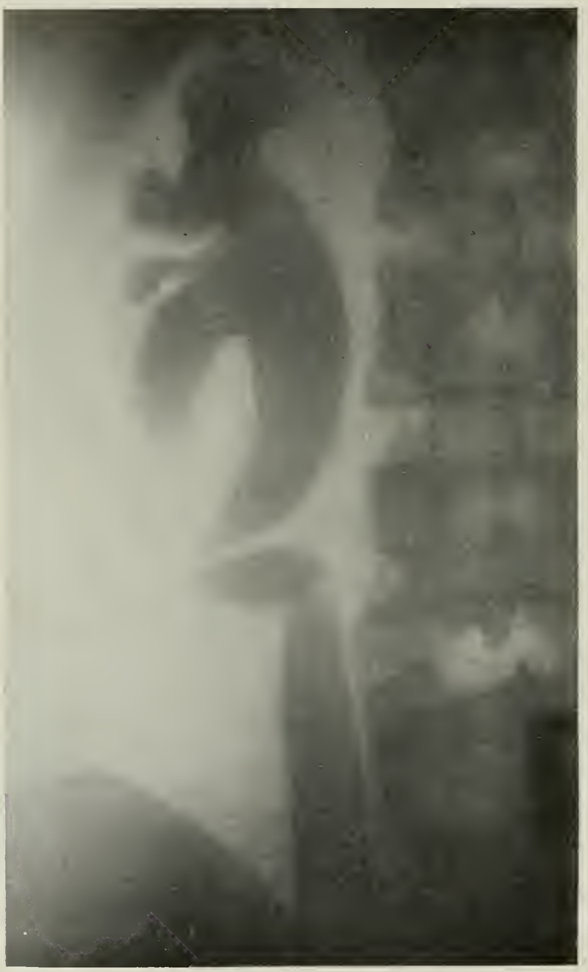

Fig. 2. Illustrating Case 1; Patient in Sitting Posture with Exhalation

Note the two kinks in the ureter, which simply mean that the ureter, which is elongated as well as increased laterally, is settling down with the prolapsing kidney. The best evidence that such kinks do no harm is the clearing up of symptoms by the simple therapy of ureteral stricture dilatation.

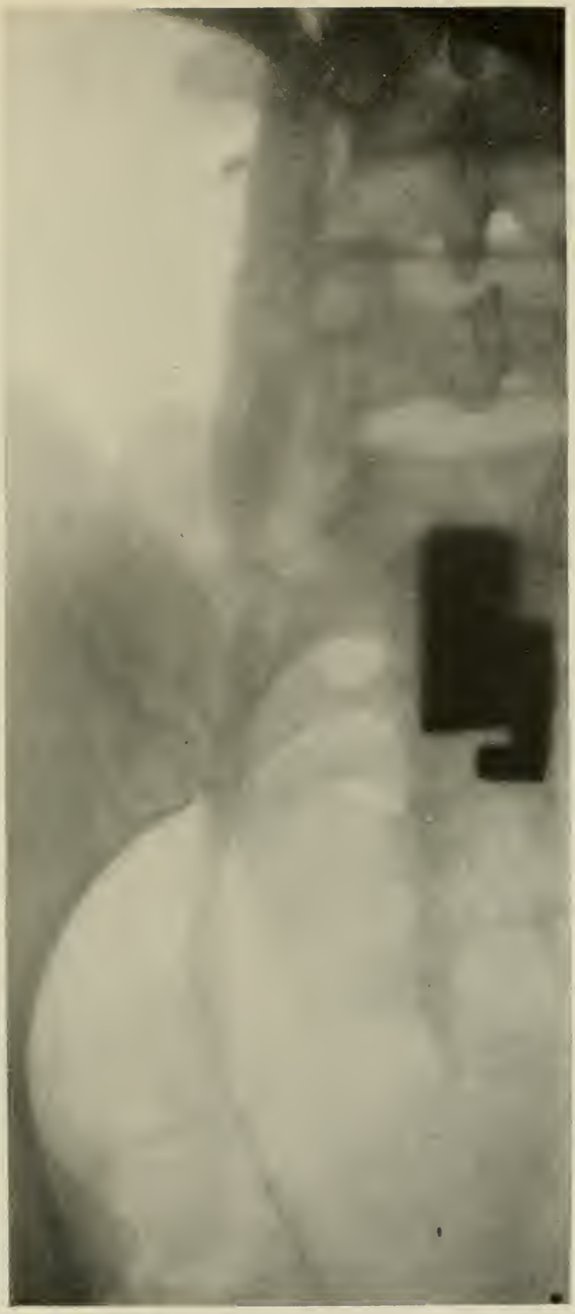

FIG. 3. ILLUSTRATING CASE 1

Note the widely dilated abdominal ureter as in figures 1 and 2, and the slightly dilated pelvic ureter. The only hang of the wax bulb was at a point 3 cm. above the bladder, but it is probable that the patient has a periureteritis throughout the pelvis, preventing the wide dilatation seen in the abdominal portion. The two black lines paralleling the ureteral catheter below the pelvic brim represent sodium bromide filtering down beside a very long tapering wax bulb 5 to 6 cm. in length.

was found that she had poor kidney elimination and when fluids were forced she developed pain for the first time in the upper right flank. There have been attacks of this pain off and on for the past few months, at times the cessation of pain being followed by the passage of a large quantity of urine. There have been no recent bladder symptoms.

Investigation showed extreme oliguria, the output, however, improving with sufficient intake. There was bilateral ureteral stricture, the left side, where there had been no symptoms, showing such a dense stricture that a renal catheter would not pass on the first investigation. The dilated right kidney and ureter held 35 cc. and showed much pus and a colon bacillus infection. The left side showed an incipient dilatation, holding 11 cc. and containing pus and a colon bacillus infection. Because of the character of her past history of pregnancies and her present condition we decided to remove her two months' fetus.

After 4 dilatations on the right side up to 5.6 mm. and 3 on the left side up to 4 mm., the patient was allowed to return home with the idea of returning for further treatment after improvement in her general health. In December, four months later, she developed a severe attack of pyelitis on the right side and her surgeon wished to operate and drain the right kidney. Knowing the precarious condition of both kidneys and believing in the possibility of getting good drainage by the natural route, I strongly opposed this proposition.

The patient returned in February, 1921. At my request her nurse had kept a daily urinary chart for the previous month. The daily output of urine had varied from 4 cc. in the twenty-four hours to 2000 cc. On nineteen days of the month the total daily output had been 200 cc. or under. On the afternoon of admission the interne gave an intramuscular injection of phenolsulphone phthalein and on catheterizing the bladder at the end of the first and second hours recovered no urine. The following morning, sixteen hours after the injection, 150 cc. of urine were obtained, showing a phthalein output of 15 per cent. On forcing fluids to a minimum daily intake of 2000 cc. the daily output promptly rose to a point varying from 1 to 2 liters.

Investigation showed that both strictures had remained fairly well dilated and with the improved drainage all traces of pyelitis had disappeared from the left kidney. The patient was still having more or less constant pain in the right kidney region and her chief complaint was the inability to do things because of physical exhaustion. After a thorough dilatation of each side, the wax bulb being carried up to 6 mm. on the right side and 5 mm. on the left side, the patient spent three weeks under Dr. Barker's medical care and went home considerably improved.

Early in June, 1921, she returned at our request for investigation. The pain in the right kidney region and her headaches had disappeared, her appetite was good and her general health had greatly improved, her only complaint being lack of strength. Both ureters were still well dilated and during this last period at home all traces of pyelitis had disappeared from the right kidney.

The patient came again at our request in October, 1921, when we found the stricture areas still well dilated and the right kidney pelvis holding 24 cc. Her first functional test on her first visit had shown after intravenous phthalein an appearance time on the right side of five minutes, quantity in half an hour 20 cc. and percentage output 27. On the left the appearance time was seven minutes, quantity 25 cc., percentage 26. On her second visit in February 1921 the right side secreted in an half hour 185 cc., 27 per cent and the left side 245 cc., 19 per cent. On her last visit in October 1921, the test was about equal on the two sides.

Case 2 (see figs. 4 and 5). Mrs. McC., aged thirty-one years, referred by Dr. L. F. Cosby of Abindgon, Va., in September, 1920. She had had four children, the youngest being four weeks old. There had been no trouble with her first three pregnancies. Throughout this last pregnancy she had not been well, being troubled chiefly with nausea, and for two months before the birth of her child she had had attacks of pain in the back and vomiting spells. After the birth of the child there was still much backache and there were severe attacks of pain situated chiefly under the right shoulder blade with chills and fever, the temperature reaching from 103° to 104°F. At first these attacks were thought to be due to the gall-bladder, but when pus and bacteria were found in the urine the diagnosis was changed to pyelitis.

Investigation showed bilateral stricture with bilateral colon pyelitis. The right side held 55 cc. and the left side 12 cc. Five dilatations of each side, the bulb being carried up to 5.5 mm. resulted in complete clearing up of the leukocytes and in a negative culture with complete disappearance of the patient's symptoms. The patient was in the hospital five weeks, gaining 10 pounds in weight, and eight weeks after returning home she wrote that she was feeling extra well in every way and had gained 6 pounds more. The x-rays showed a marked abscess formation about several teeth and these were to be extracted after she returned home.

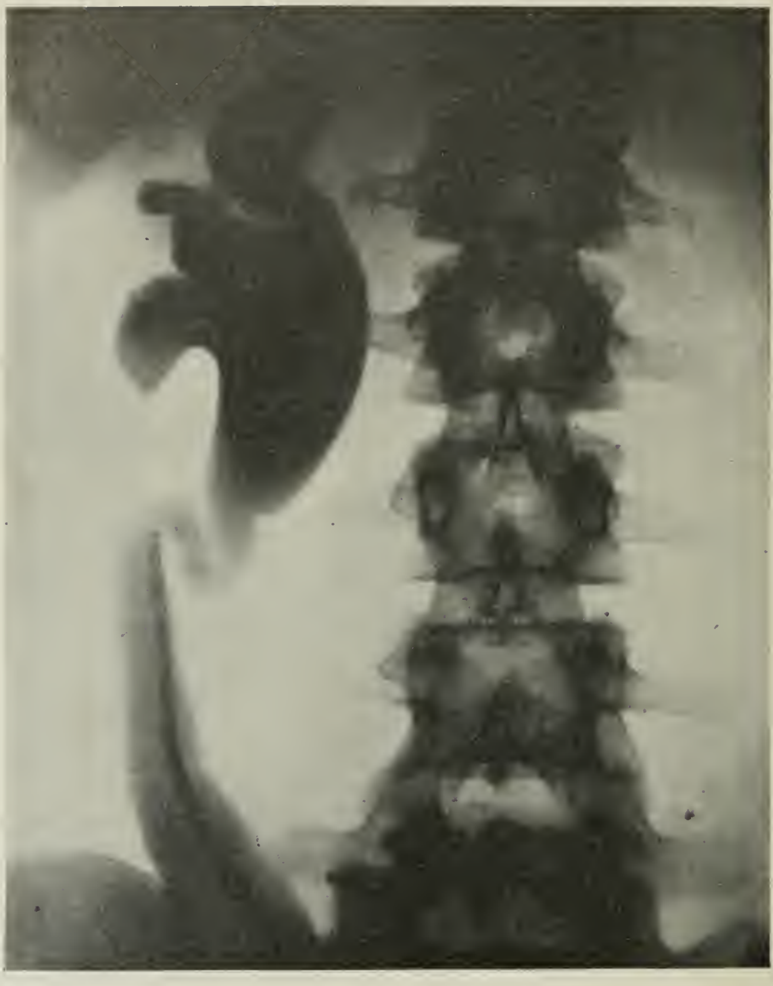

FIG. 4. ILLUSTRATING CASE 2; BILATERAL STRICTURE OF THE URETER, BILATERAL PYELITIS OF PREGNANCY AND OF THE PUERPERIUM

Note right kidney and dilated upper ureter holding 55 cc. Apparent ureteral kinks stopping the whistle tip shadowgraph catheter short of the kidney. Complete clearing up of infection and of symptoms after 5 dilatations on each side. See also figure 5.

Case 3 (see fig. 6). Mrs. S., aged thirty-three years, referred by Dr. Julius Friedenwald August 2, 1915. About three years ago the patient noticed an uneasy feeling in the lower abdomen over the bladder.

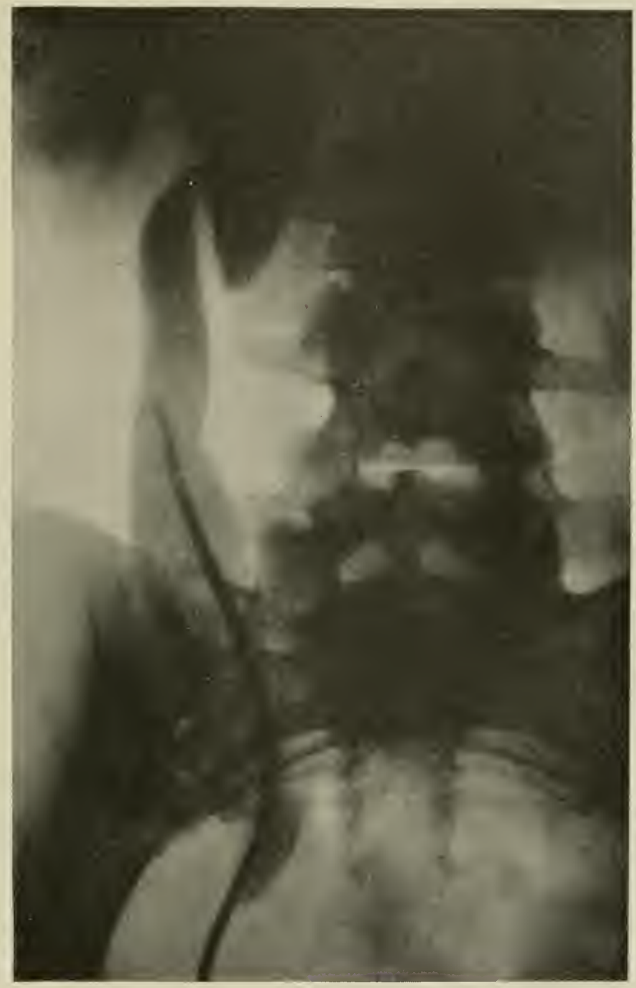

FIG. 5. ILLUSTRATING CASE 2

Note the stricture area in the iliac gland region. The wax bulb placed 10 cm. back of the catheter tip hangs at a point 8 cm. above the bladder and drags through a diffuse stricture area. See figure 4.

At first these attacks occurred every two or three months, beginning as an uneasy feeling in the bladder region, increasing to a dull aching, and finally becoming a severe pain located over the bladder, and passing up the flank around to the back. At first the pain extended only to the right back, but more recently the attacks have become more frequent and severe and have been located more in the left back. Aspirin and whiskey usually gave relief and she was treated chiefly for indigestion.

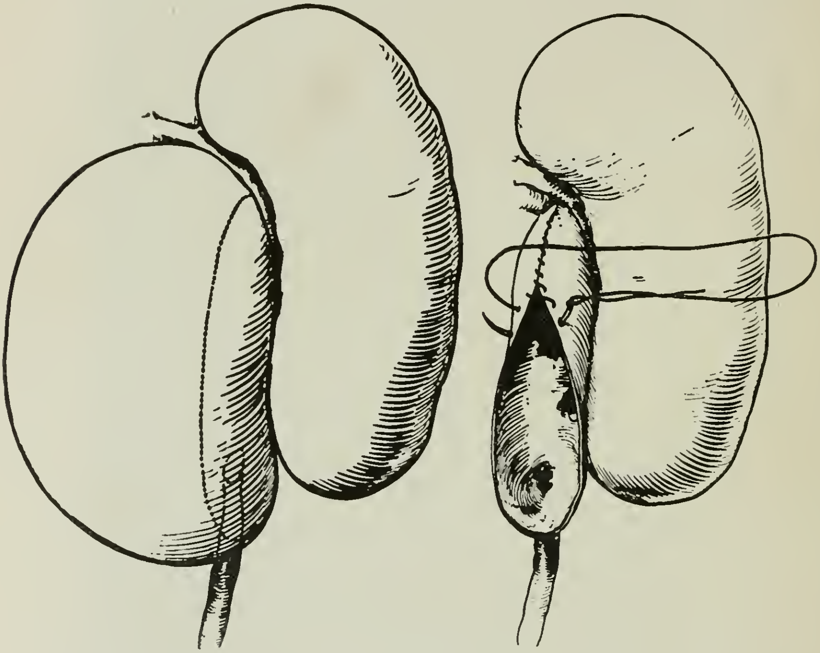

Fig. 6. Illustrating Case 3; An Ideal Case for Pyelectomy

The pelvis held 360 cc., but the functional test was normal and equal to that of the opposite kidney. The bladder urine was normal. At operation it was found that the dilatation had been practically entirely at the expense of the pelvis, the calices showing very little disturbance. The renal vessels skirted the upper pole of the dilated pelvis, and the ureter with a lumen of 6 mm. diameter entered the lower pole of the pelvis without angulation. Complete resection of pelvis. Kidney content after operation 8 cc.

Dr. Friedenwald found the urine normal and an x-ray of the urinary tract was negative. After treating the patient for several weeks as a gastrointestinal case, he found in one of her attacks that there was an indefinite mass in the upper left flank and he then asked me to investigate her urinary tract. The patient had an attack of ulcerative sore throat two years before the onset of her present illness, and in the past two winters has had attacks of tonsillitis.

Investigation showed a dense stricture of the urethra, a normal appearing bladder, trigonum and ureteral orifice regions. A stricture was located in the left ureter 3 cm. above the bladder, and on the first catheterization 7 ounces flowed in a steady stream from the left kidney. On the second investigation, when the patient had a large indefinitely outlined mass apparently semisolid on palpation, in the left upper flank region, the steady flow of clear urine measured 12 ounces. After dilatations over a period of six weeks she became free from pain while in the recumbent position, but after being on her feet two or three hours the dull pain in the left kidney region would return. This seemed to indicate that the dilatation of the ureteral stricture had resulted in good drainage when postural conditions were favorable, but that the saccular pelvis filled when the patient was erect and caused urinary blockage from kinking or pressure conditions between the upper ureter and the distended pelvis.

I operated on September 15, 1915, resecting the kidney pelvis and leaving just enough tissue for closure (see fig. 6).

The convalescence was uneventful, but on later investigation of the left kidney it was found that the patient had developed a staphylococcus aureus pyelitis. This was treated several times with lavage with a 1:500 silver nitrate solution, and the patient returned home early in November to return for investigation after the Christmas holidays.

On her return January 31, 1916, she had gained 10 pounds in weight, and had been gaining strength rapidly. There was still some uneasiness at times in the left kidney region, but the kidney pelvis was found to hold 8 cc. and the urine was free from pus and negative to culture. The ureteral dilatation was carried up to a 6 mm. bulb, and the patient went home to return in the fall. She motored from Fairmont, W. Va., to Baltimore, about 275 miles, on November 9, 1916, and claimed to be in perfect health. The urine catheterized from the bladder was normal.

A fresh attack of tonsilitis at Christmas, about fifteen months after her operation, was followed in a few weeks by the development of pain in both sides of the pelvis and by attacks of pain in the right kidney region with slight elevation of temperature. She returned on March 27, 1917 when it was found that the left ureteral stricture area obstructed a 5 mm. bulb moderately, but there was no urinary infection and no increase in the left kidney capacity. Investigation of the right ureter revealed a stricture with an apparent kidney capacity of 10 cc. Both sides were dilated to 6 mm. and the patient's tonsils were removed.

She returned for investigation and dilatation in April, 1918, having developed slight pain in the left kidney region after vaccination against smallpox. Both sides took large bulbs without marked obstruction and frequent reports since indicate that the patient is in good health.

Case 4 (see figs. 7 and 8). Mrs. A., aged forty-seven years, referred in April, 1919 by Dr. Thomas Talbott. She first consulted Dr. Talbott five years previously because of a pain low in the right pelvis and a dollar-sized spot of pain in her right lumbosacral region if she was on her feet too much. Floating right kidney was diagnosed and the patient had suffered considerably in the meantime in spite of medical treatment. Ten weeks previously Dr. Talbott had sent the patient to St. Agnes Hospital where it was found that she had a right hydronephrosis, but that in spite of this the right kidney was doing the better work. A one-hour test with both sides catheterized yielded from the right kidney 100 cc. with 35 per cent of phthalein, and from the left kidney 28 cc. with 10 per cent phthalein. One week later a similar test yielded, right 85 cc., 25 per cent, and left 34 cc., 10 per cent. Plain x-rays were negative. After these tests the patient's symptoms had been worse. She had a chill after the second test, and the pain low in the right pelvis had been increased and she had developed discomfort in the right hip and in the bladder.

This history led me to suspect bilateral ureteral stricture and investigations revealed two strictures on the right side with a hydronephrosis of 55 cc. and a moderate colon bacillus infection. The left ureter showed two strictures, the kidney pelvis held only 2 cc. on several tests but the urine was negative to culture. The bladder urine always showed pus, bacteria, hyaline and granular casts, and considerable albumin. The casts were found to be coming from both sides, and this fact, together with the low phthalein output on the left, and very small pelvis capacity, led me to diagnose a probable small granular kidney on the left side.

Pyelogram studies (figs. 7 and 8) showed what was interpreted (incorrectly as operation proved) as a much dilated pelvis and calices, and only slight dilatation of the ureter. After this thorium pyelogram the patient suffered a severe reaction for several days with high fever, chills, and much pain, nausea, vomiting and general prostration. After 2 dilatations of the right ureter and 1 of the left we decided from the x-ray

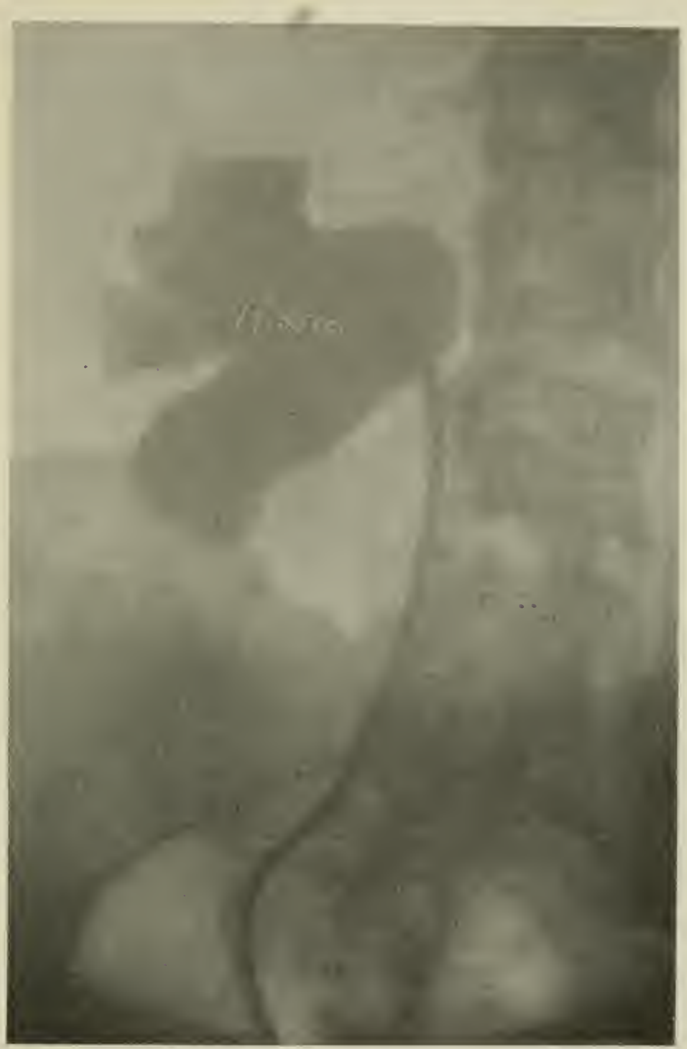

Fig. 7. Illustrating Case 4

Note the large intrarenal dilatation with the renal catheter swinging up either in front of or behind the pelvis. It is apparent that the contained fluid is trapped in the kidney pelvis, for a very slight amount has found its way back into the ureter. See the slight dilatation of the pelvic ureter.

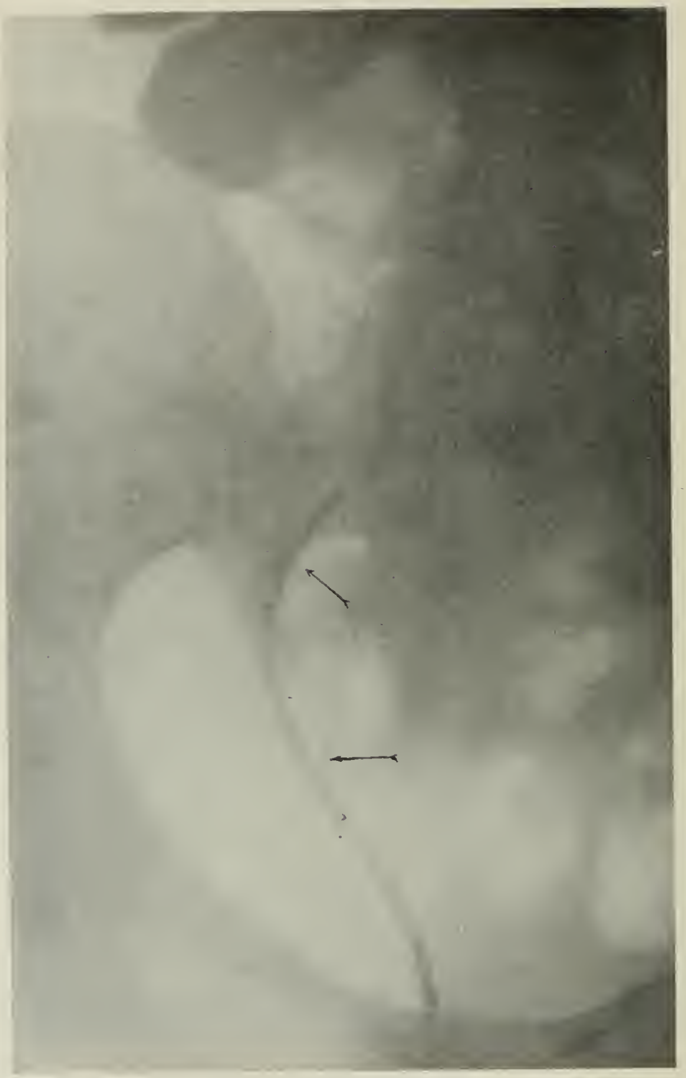

Fig. 8. Illustrating Case 4

The catheter is withdrawn until the bulb catches in the lower of two stricture areas. The upper stricture was 8 cm. above the bladder or 4 to 5 cm. below the pelvic brim and the lower stricture was 3 to 4 cm. above the bladder. Note the slight dilatation of the ureter, the lumen being slightly wider than the peripheral diameter of a normal ureter.

studies that the right side, which was doing by far the better work, would not be materially benefited by dilating the strictures in the lower ureter, because of the prolapsus of the hydronephrotic kidney and its angulation with the upper ureter.

Operation, June 24, 1919. We made a rather large incision parallel with the twelfth rib. The liver border showed plainly in the wound. The kidney was easily delivered by its adherent fatty capsule and was found to be a mere shell. The dilatation which had appeared to be of the pelvis on the x-ray plate was found to be almost entirely at the expense of the kidney substance.

The ureter was only slightly dilated and it came directly into the lower portion of the kidney without any kink as the kidney was lifted out of the wound. It is probable that the former failure of the kidney to drain was due to its weight and prolapsus and the presence of periureteral inflammation in the kidney capsule region. The upper third of the kidney appeared to be the better secreting portion, the lower two-thirds of the kidney cortex was scarred and depressed and rather cystic. The thinnest portion was in the lower third and the kidney was opened through the anterior wall in the lower third.

The bleeding from the kidney substance was checked with whipped catgut sutures. The ureter having been found with the uterine sound, a whalebone was then passed down, a no. 16 graduate bougie was passed along the whalebone, and the latter was withdrawn. This dilated the upper ureter to 5⅓ mm. which was about the size as revealed by the x-ray.

Two plain gauze drains were laid in the kidney pelvis through the incision to take care of slight oozing and a fine rubber tube was sutured in the edge of the kidney wound through which to irrigate the kidney for a few days and two finger drains were put through the lumbar wound down to the kidney cortex.

In order to get a good fixation of the kidney a linen suture was whipped through the densely adherent perirenal fascia at its upper pole and the ends of the linen were carried up through the intercostal space above the last rib and tied. The further fixation was favored by suturing the fatty capsule into the abdominal muscle closure which was done with twenty-day catgut.

The patient took mostly gas and oxygen, being relaxed early in the operation with ether. The kidney outline was of about normal size.

The patient returned on September 26, 1919, three months after operation. She was doing very well, had no pain in kidney region, and no bladder symptoms. She complained of a good deal of burning low down in the right side.

Cystoscopy. A $4\frac{2}{3}$ mm. wax bulb enters with much obstruction together with pain and considerable bleeding from the right ureter. On withdrawal, the bulb hangs firmly at a point 8 cm. above the bladder and at a lower area on coming out. Culture from the right kidney is positive.

Note made on December 12, 1919. The patient has gained 14 pounds and looks and feels much better. When on her feet all day she develops some pain in the right back during the afternoon. Formerly her pain in the right back began soon after she arose in the morning.

She was last seen on March 18, 1920. She had had in all 5 dilatations on the right side, the bulb being carried up to 5.3 mm. and 2 dilatations on the left side up to 4 mm. She still had pain at times in the right back and at times low in the ureter region. On the left side there was slight pain at times just medianward from the anterior superior spine. Her discomforts were far less than before her operation and treatment and her general health was much improved.

Case 5 (see figs. 9 and 10). Mrs. M., aged twenty-eight years, was first seen at her home November 23, 1919, in consultation with Dr. John Bishop, when her first child was one week old. Her temperature was 103.5°F. on my first visit and the right flank was distended by an extremely sensitive mass considered to be an enlarged right kidney lying completely below the costal border. The patient gave a history of having had symptoms due to floating right kidney for six years, and this was the third very bad attack in that time. The urine showed albumin, casts, pus, blood, and bacteria. This pyelitis attack subsided under medical, dietary and postural treatment, and the patient came to my office four months later.

On February 12, 1920 she gave a history of having had her tonsils removed at twelve years of age, when she had nearly bled to death from hemorrhage. She still had occasional soreness in the left tonsil region and a tendency to earache. Examination showed some adenoid tissue in the left tonsil base, cryptic, and containing some gray retention areas. Several teeth had been extracted, the last one about six months previously after x-rays. She had had two normal menstrual periods since her baby's birth. She complained of some pain at times in the right flank and felt an abnormally tired feeling all the time.

Examination revealed a displaced uterus, which seemed enlarged, congested and very tender. This was replaced, and a no. 3 Hodge pessary was inserted which kept it in excellent position and gave her much comfort.

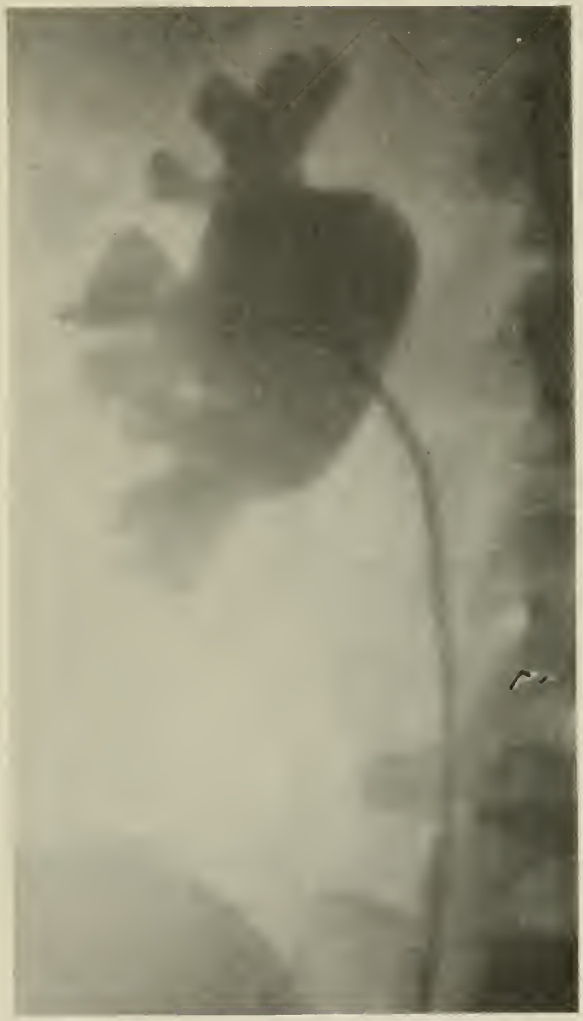

Fig. 9. Illustrating Case 5

Compare figure 10. Patient in prone position, full exhalation, 38 cc. NaBr solution. Note the good high position of the kidney, the dilatation occurring with about proportionate enlargement of the pelvis and calices, the x-ray catheter tip in the middle calyx, and the total lack of information concerning the ureter or its mode of entrance to the pelvis.

On March 18, 1920, the first kidney investigation was made showing a right hydronephrosis and two stricture areas in the lower ureter. After the kidney pelvis was filled the upper ureter was shut off so the kidney could not drain until the catheter was pushed up higher and reached the kidney pelvis when there was rapid drainage of 58 cc.

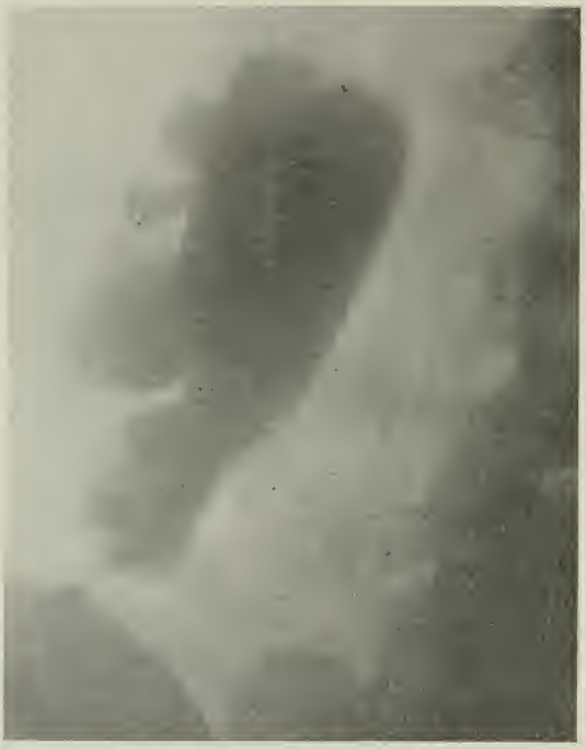

Fig. 10. Illustrating Case 5

Compare figure 9. The patient has been given the semi-erect posture, and the x-ray catheter has been withdrawn ultil the wax bulb hangs in the stricture area. No further injection made, and note the complete absence of fluid in the ureter indicating a complete trapping in the kidney pelvis. Note the great ptosis of the kidney from the costal region in figure 9 to a position near the iliac region, and the change in shape of the pelvis as it rides down the iliopsoas muscle.

The urine from the bladder showed a fairly large number of leukocytes, myriads of rod bacilli, no erythrocytes, considerable albumin. The right kidney urine had many leukocytes, a few erythrocytes (trauma), and on culture gave a colon bacillus.

On April 12, 1920, the patient reported getting over her first dilatation well and that the kidney had apparently not become overfull since the treatment. On passing the no. 9 renal catheter with wax tip and 4.5 mm. wax bulb the urine ran in about normal spurts, showing no evidence of residual in the kidney. On injection the kidney took 55 cc. to full feeling. The bulb again showed two areas of infiltration in the lower ureter.

On April 22, 1920, the ureteral dilatation was carried to 5 mm. and the patient was not seen again until about one year later, on March 17, 1921, when she reported that she had never enjoyed better general health. She had not had another pyelitis attack with fever and prostration, but she had had some attacks of what she called prolapse of the kidney, characterized by a sharp pain in the flank which was relieved by getting to bed with pillows under her left hip and her head flat on the mattress. She had found in past years that she could ward off her attacks by this manouvre, which of course tended to float the kidney into a higher position, relieving the ureteropelvic obstruction and allowing drainage. Since her ureteral dilatations she noticed that if she was on her feet two or three hours in succession she began to develop the "prolapse of the kidney." At times when down town shopping she would have to call a taxi and hurry home to ward off a threatening attack by the posture method.

The patient had gained considerably in weight, and had an excellent color; the bladder urine was far less purulent than on previous tests. She had been wearing a special corset to help keep the kidney in position, so I felt that she had had a sufficient time to demonstrate how much dilatation of the stricture together with conservative measures would do, and that she would probably require a nephropexy to rid her of the threathened Dietl's crisis.

Not wishing to operate until functional tests and x-rays had been made the patient was sent to the hospital and on March 23, 1921, the roentgenograms (fig. 9 and 10) were obtained. As seen by these pictures the sodium bromide was trapped as soon as the kidney became full and none of the fluid is pictured in the ureter, even after withdrawal of the catheter until the bulb caught in the stricture area, as shown in figure 10. The kidney took only 38 cc. of sodium bromide for these pictures, but it is probably that there was already some residual urine in the pelvis, for the kidney shadow in these plates would indicate a content of approximately 2 ounces. Before returning the patient to the ward for a functional test the head of the table was dropped to give her an exaggerated Trendelenberg position, when massage of the right kidney emptied 30 cc. of fluid. Thinking this would get rid of her overdistension and pelviureteral obstruction she was sent back for the functional test with the catheter still in the lower right ureter. An intramuscular injection was made of the phthalein and a two-hour test was taken. From the catheter in the right ureter only 5 cc. were recovered in the first hour showing a trace of phthalein, and 3 cc. the second hour, showing 5 per cent of phthalein. It was evident that partial stasis persisted at the pelviureteral junction. From the left kidney through the bladder the first hour yielded 100 cc. with 20 per cent and the second hour 250 cc. with 5 per cent of phthalein.

Although the patient had never had symptoms on the left side this test showed a low phthalein output and I did not care to operate on the right kidney until we could determine the condition of the other one. The ureter was tender both at the pelvic brim region and in the broad ligament. On April 9, an attempt was made to catheterize the left side. A no. 9 renal catheter with wax tip and 3.6 mm. wax-bulb entered the ureter only a short distance, causing much pain and obstructing so firmly that I did not dare send it farther. With the catheter in the lower end of the left ureter the patient was returned to bed for a differential functional test. The phthalein was injected in the deltoid muscle and from the left kidney color appeared in three minutes and from the right kidney through the bladder in one hour. No estimation is recorded.

The left ureter was catheterized again on April 21 and on May 5, a 4.6 mm. bulb being used the last time, and this bulb apparently obstructed permanently when its distal shoulder was in 8 cm. above the bladder. On withdrawal it hung at about 4 cm. above the bladder. Another reason to indicate operation was the fact that the patient was now two to three months pregnant, and we felt that she would be more likely to have good drainage if the right kidney were given a high fixation.

Operation, May 10, 1921. An incision was made parallel with the twelfth rib, of generous length, to render delivery and examination of the kidney easy. The dilatation was found to be about equally intrarenal and extrarenal, leaving the cortex considerably thinned. The visible portion of the upper ureter was about 8 mm. in diameter, it seemed to have a good sized opening into the pelvis and there did not seem to be special bands kinking the ureter. It is possible that the fascia 6 to 7 cm. below the pelviureteral junction may have bound the ureter to the back in a manner to cause a kink when the kidney prolapsed, but it is more likely that the secondary kink took place at the junction of the ureter and pelvis when the kidney became misplaced downward, or the obstruction may have been due to lateral pressure when the pelvis became full. The entire region appeared as though it would give free drainage if the kidney were well fixed in high position.

A Brödel triangular suture was passed rather superficially in the cortex and its ends were brought through the tissues immediately below the twelfth rib and tied. We did not dare pass these sutures above the rib because of a low diaphragm. The usual middle and lower pole sutures attached to the anterior edge of the quadratus muscles were omitted from fear of the possible influence of the colon bacillus infection in the kidney pelvis. Use was made of the perirenal capsule to hug the kidney up to the lumbar wound.

The patient passed through her pregnancy without further symptoms except in the later months when she experienced a little soreness at times in the kidney region, which she thought due to the unusually active fetus.

In December, Dr. Karl Wilson reported that she went through her labor and puerperium without fever, the urine showing a slight increase in pus and albumin for a few days before delivery, and the patient complaining of slight soreness in the right kidney region for a day or two after.

On Christmas day her baby was two weeks old and the patient was feeling so well that she induced her husband to bring her in from the suburbs to pay the compliments of the season. I warned her against too much activity so soon after child birth. Her maid fared so well for the holidays that she took about a week off to celebrate on moonshine, and this left the patient with far more household work than she was fitted for. She next reported at the office on January 27, 1922. For the past two weeks she had had a good deal of pain through the right kidney region. About one week before coming she had had a chill and a fever. For the last three days the right kidney had felt enlarged and tender. On catheterization of the right kidney a 4 mm. bulb had no appreciable hang coming out, showing that the ureteral stricture was still well dilated. The bladder urine and the right kidney urine showed no leukocytes or albumin, and a culture was negative. This was evidence that the patient's pyelitis had cleared up spontaneously either during her pregnancy or during the seven weeks since the birth of her child.

We advised rest in bed with the foot of the bed elevated, and this was carried out with partial fidelity, but the patient cared for her baby and thought nothing of reaching over to its crib and lifting the heavy child into bed with her. The pain in the right kidney region became more persistent and there were occasional severe attacks with nausea and vomiting. On March 20, I passed a 4.6 mm. bulb and got a slight hang at two points about 10 and 3 cm. above the bladder. It was evident that the strictures were not responsible for the patient's increasing misery and that she had again developed an obstruction near the kidney. The bladder and kidney urine were again negative microscopically and on culture.

Early in April the patient again entered the hospital where we could better control her rest. She continued to have pain, developed almost constant nausea and was losing weight. On April 12 she had a chill and a temperature of 102°, and the right kidney felt as if it were considerably distended.

On April 15, 1922, I operated a second time, approaching the kidney from in front through the right semilunar line. The ureter was found densely bound to the posterior abdominal wall at a point just below the kidney. The pelvis was thick-walled and edematous, and on making a 3 to 4 cm. incision in its anterior wall I found the ureter entering in the anterior aspect near the lower end of our pelvis incision, while from the outside it had the appearance of entering in the posterior aspect of the pelvis. The ureter was cut free from its bed of adhesions to the posterior abdominal wall and this left 3 or 4 cm. of slack ureter which might have been resected for an end-in-pelvis anastomosis, but being anxious not to prolong the operation and not to interfere with the ureteral circulation, we extended the pelvis incision down through the ureteral orifice and down the slack portion of the ureter until the lower end of the ureteral incision came up easily to the lateral walls of the pelvis incision. The ureteral and pelvis walls were then sutured over a no. 16 male catheter. This catheter entered the upper ureter for 5 or 6 cm. and two eyes were cut in the catheter where it traversed the pelvis. The catheter was sutured to the upper end of the pelvic incision and brought out through the abdominal incision. To make sure of good pelvic drainage a second small rubber catheter was placed in the pelvis beside the main catheter and sutured to the pelvis with a no. 1 plain catgut.

Gauze-rubber wicks were placed about the rubber tubes as an extra protection for the peritoneum which had been opened and sutured early in the operation. In the first twenty-four hours after operation the right kidney secreted 1000 cc. through the two catheters, besides some urine that leaked by the wick drains, and probably some that found its way through the large catheter into the ureter and bladder.

After the third day the kidney pelvis and bladder were irrigated through the rubber tubes twice daily with 1:5000 silver nitrate solution and on May 1 the drainage tract had entirely closed.[2]

Case 6 (see figs. 11 and 12). Mrs. M, aged twenty-five years, referred August 11, 1921 by Dr. W. M. Coppridge of Durham, N. C. The patient was well up to the time of her marriage one year previously. Ten days after marriage she was taken with a pain in the upper right flank and on the following day had a chill and fever. She saw Dr. Jeffries Buck in Baltimore on the third day and he diagnosed a right pyelitis. There had been bladder pressure and frequency for three days before her attack of pain. After one week she returned to Durham and was given urotropin. Early in January she had rather a sharp pain in the right back lasting only a few seconds. This is the only pain she had ever had which she signified as a kidney colic. In March, Dr. Coppridge had found bilateral kidney infection and since then had given lavage 6 times on each side. He had recently taken a pyelogram and found an immensely enlarged right kidney pelvis.

Investigation showed bilateral ureteral stricture, and bilateral hydronephrosis with a colon bacillus infection. The right pelvis held 125 cc. and the left 18 cc. The patient remained with relatives in the city and came to the hospital every few weeks for ureteral dilatation, being submitted to 6 dilatations and reaching a 6 mm. bulb on each side in a period of three months.

Her general health improved and she was comfortable while in bed, but after being on her feet for a time she developed considerable dragging pain in the right kidney region. Occasionally, on filling the right kidney to capacity, the fluid trapped, and the patient had typical pyelitis attacks lasting several days with chills, high fever and prostration. Her phthalein test on August 30, after intravenous injection, showed an output in half an hour from the right side of 65 cc. of urine with the faintest trace of phthalein, on the left side, which was catheterized, the color appearing in ten minutes and the half hour showing 160 cc. with 12 per cent of phthalein.

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[2] Before sending this paper to the printer in September more than four months after operation, this patient was seen and found to be in excellent condition. She said that she had not an ache or a pain and that she weighed 135 pounds, her best previous weight having been 110 pounds.

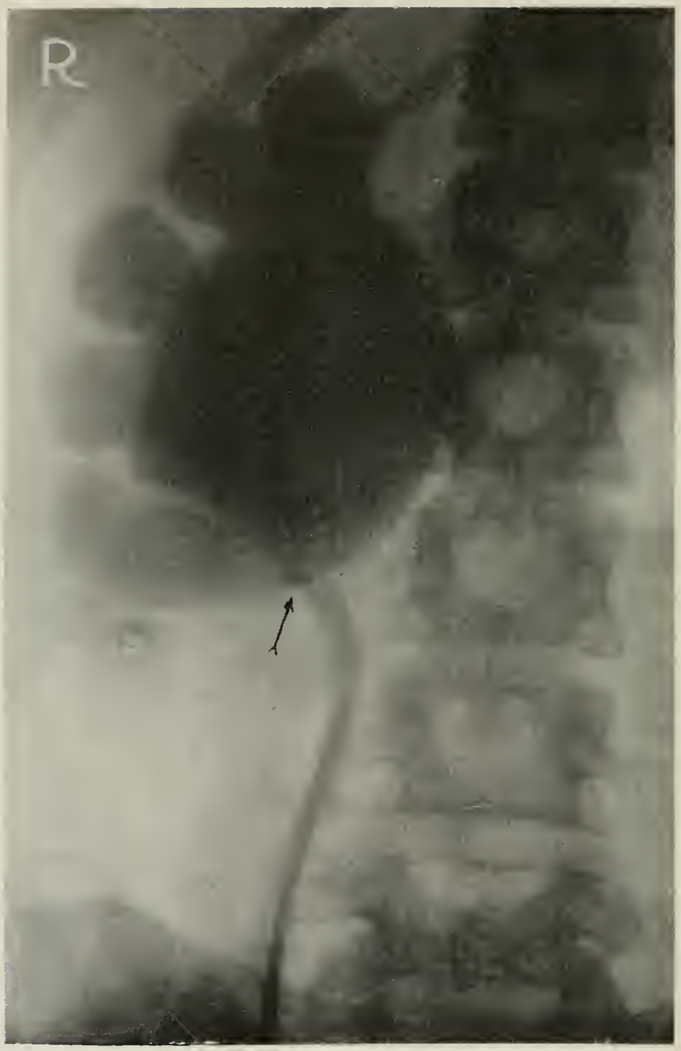

FIG. 11. ILLUSTRATING CASE 6

Compare figure 12. Right kidney content 125 cc. Note the intrarenal character of the dilatation and the rounded pelvis. Note the dark area at the pelviureteral junction, probably an end-on view of a segment of angulated ureter. Note the relatively slight dilatation of the ureter.

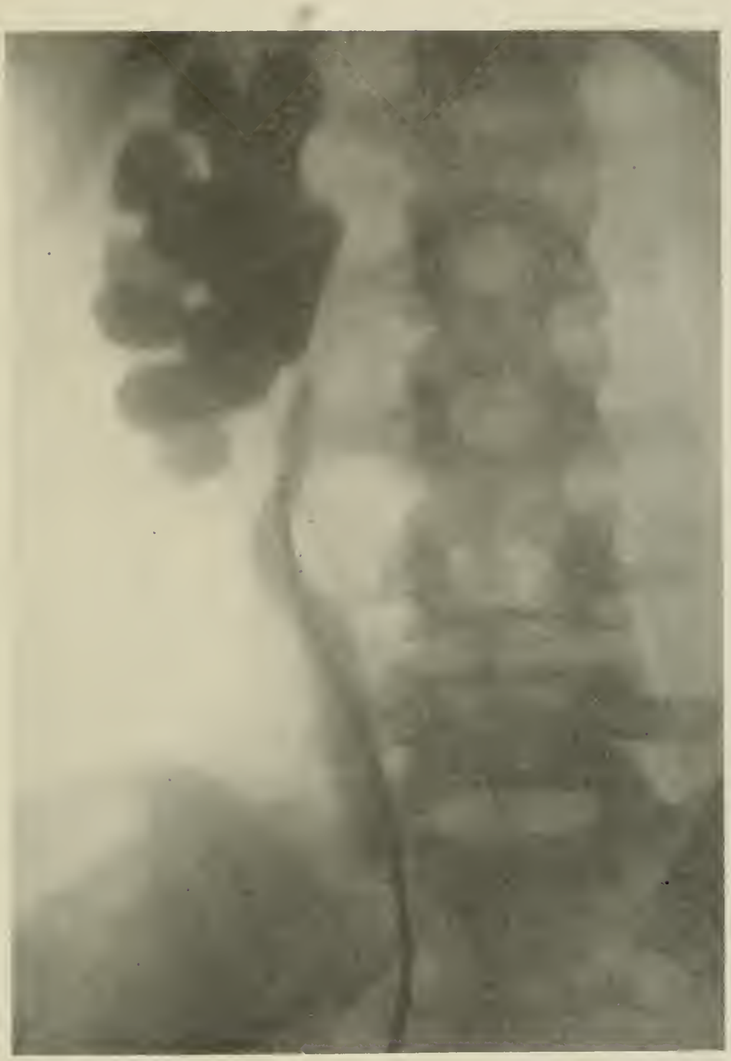

Fig. 12. Illustrating Case 6

Compare figure 11. The kidney content after operation 40 cc. Note the comparative narrowing of the upper centimeter of ureter described at operation as being somewhat infiltrated. The ureteral stricture was 10 cm. above the bladder or about 3 cm. below the pelvic brim. Phthalein secretion from the right kidney increased from a mere trace to 14.5 per cent.

On October 5, the test showed from the right side 50 cc. with a trace of phthalein, and from the left 70 cc. with 15.5 per cent.

On November 11, three months after the beginning of ureteral treatments the phthalein output had risen from a trace to 5 per cent on the right, and from 12 to 31 per cent on the left. Because of the recurrent attacks of pain in the right kidney region due to some form of secondary obstruction in the kidney region, I operated on November 30, 1921. As indicated by the x-ray (fig. 11) we found that the dilatation had occurred about equally at the expense of the pelvis and the calices, in other words the dilatation was found to be largely intrarenal. By means of a previously introduced catheter and a gravity apparatus we filled the pelvis partially with sterile water and could thus study the mechanism of her obstruction. There were some fibrous bands across the upper 2 cm. of the ureter. These seemed to come into play as binding structures only when the pelvis approached fulness. (See the dark spot at the pelviureteral junction indicating an end-on view of a portion of the ureter (fig. 11).

These connective tissue bands were easily brushed free and on opening the kidney pelvis and passing Hegar dilators nos. 7 and 8 (24 Fr.). I found the upper centimeter of the ureter somewhat narrowed. The ureter lumen below the junction was fully 8 mm. in diameter. Because of the relatively small pelvis we resected only a small oval area, measuring 3 to 4 cm., from the posterior wall. In closing with a whipped lock stitch no. 2 plain catgut we left the upper centimeter of the pelvis wound open as a safety valve in case the lower stricture area should temporarily close after the operation. Three wick drains were carried down to this opening. Fearing to pass the usual linen fixation sutures in the cortex because of the colon bacillus infection of the pelvis, we trusted our drainage tract would help in the kidney fixation, and the patient was kept in the high Trendelenberg position for a week after operation to provide for a high fixation by the drainage tract adhesions. There was considerable urine drainage for three days, very little on the fourth day, and none on the fifth day when the first wick drain was removed.

The kidney held about 40 cc. after the operation and on January 20 the phthalein test with a catheter in the right kidney showed in half an hour from the right side 42 cc. with 14.5 per cent, and from the left side 54 cc. with 32 per cent thalein. The appearance time on the right was five minutes and on the left four minutes. Her repaired right kidney is thus seen to have risen in working capacity from a mere trace on admission to 5 per cent after the ureteral dilatations, and then after operation to a higher percentage than had been obtained from both sides on admission. A letter on April 11, 1922, five months after operation says she has gained from 93 pounds to 123 pounds and feels better than for years. There is occasional slight pain in the back after unusual exertion.

Case 7 (see figs. 13 to 19). Mrs. G., aged thirty-six years, referred November 8, 1921 by Dr. William P. Graves of Boston. The patient, up to the time of her childbirth one year after marriage in 1914, had been strong and athletic, weighing 172 pounds. The childbirth resulted in a cystocele for which three months later she had an abdominal operation. Two years later she had a vaginal operation for the cystocele. From November, 1916, to November, 1919, she had three miscarriages. The history does not suggest any disturbance of the kidney function as a cause of these miscarriages; but after the last one in November, 1919, she developed an intermittent swelling in the left flank which for a time appeared about every ten days, and her family physician considered this a "phantom ovarian tumor" and later he thought this swelling might be due to threatened intestinal obstruction. The last severe attack on the left side had been in December about one year before I saw her, but in the meantime she had had occasional pain on that side.

Dr. Graves referred her because of repeated Dietl's crisis like attacks on the right side which developed as follows. In February, 1920, Dr. Graves operated, doing a perineal repair, a uterine suspension, and removal of the appendix. Ten days later she developed a severe right side pyelitis. This failed to subside under the usual remedies and "the kidney became enlarged and tender, and during the attack the left kidney became enlarged for a short period but quickly subsided." The patient became seriously ill and Dr. Chute was called in consultation. He failed to get a catheter to pass an obstruction in the lower right ureter and it was considered imperative to perform a right nephrotomy for drainage. The kidney drained from March until September, this in itself suggesting some form of ureteral obstruction, as had Dr. Chute's failure to catheterize the ureter. The intervening year following the nephrotomy closure had been marked by repeated crisis of pain and swelling in the right kidney region, recently occurring about every four days and forcing the patient to bed. Between the attacks she was comparatively well and active.

The patient was underweight (126 pounds contrasted with her best weight of 172 pounds) but she had excellent color, and except for the pain, headaches and nausea accompanying her right kidney attacks she seemed remarkably active and in high spirits, and one could scarcely believe the records of her kidney examinations.

The right kidney was a mere shell, the X-ray (fig. 13) showing a cortex rim about 2 mm. in thickness, and while the pyelogram showed pelvis and calices spread over a wide area as if capable of holding 2 or 3 ounces, the pelvis on repeated tests held only about 12 cc. to the point of pain.

The left kidney which was doing practically all the work showed an immense hydronephrosis. The trauma incident to the first investigation of the left side resulted in a complete blockage for twenty-four hours, and the left kidney mass occupied the entire left abdomen and extended beyond the midline in the lower abdomen to the right border of the right rectus muscle.

Both ureters showed a stricture and both kidneys were infected by the colon bacillus.

The phthalein test made on the day of admission with the catheter in the right kidney showed in two hours after an intramuscular injection, from the right side 16 cc. of urine, with only a trace of color, and from the left side 396 cc. of urine with 17 per cent of phthalein. The patient's attacks of right side pain became greatly reduced in frequency and severity as soon as the stricture area was dilated, but she continued to have occasional slight attacks on unusual exertion, due in all probability to a secondary obstruction at the ureteropelvic junction occurring whenever there was slight kidney ptosis (fig. 13).

It was perfectly evident from the patient's past history of attacks of pain and swelling on the left side, and from the left pyeloureterogram that she could look forward to a progressive destruction of her only available kidney. I hoped by doing a resection of the large pelvis and a fixation of the kidney to give her more adequate drainage through the upper ureter. After first dilating the left ureteral stricture up to 6.3 mm. (19 Fr.), I operated on December 1, 1921, resecting the lower two-thirds of her pelvis, and being obliged to leave the dilated upper third because the renal vessels ran across and were adherent to the upper pelvis. The kidney was found to be fully 20 cm. long and extended from the costal margin to the pelvic brim, and the large saccular pelvis extended considerably lower.

A fixation was done with 3 Brodel sutures of linen and an attempt was made to lift the kidney high enough to keep the ureter on a tension with the lower pelvis which we had reconstructed with a funnel shaped

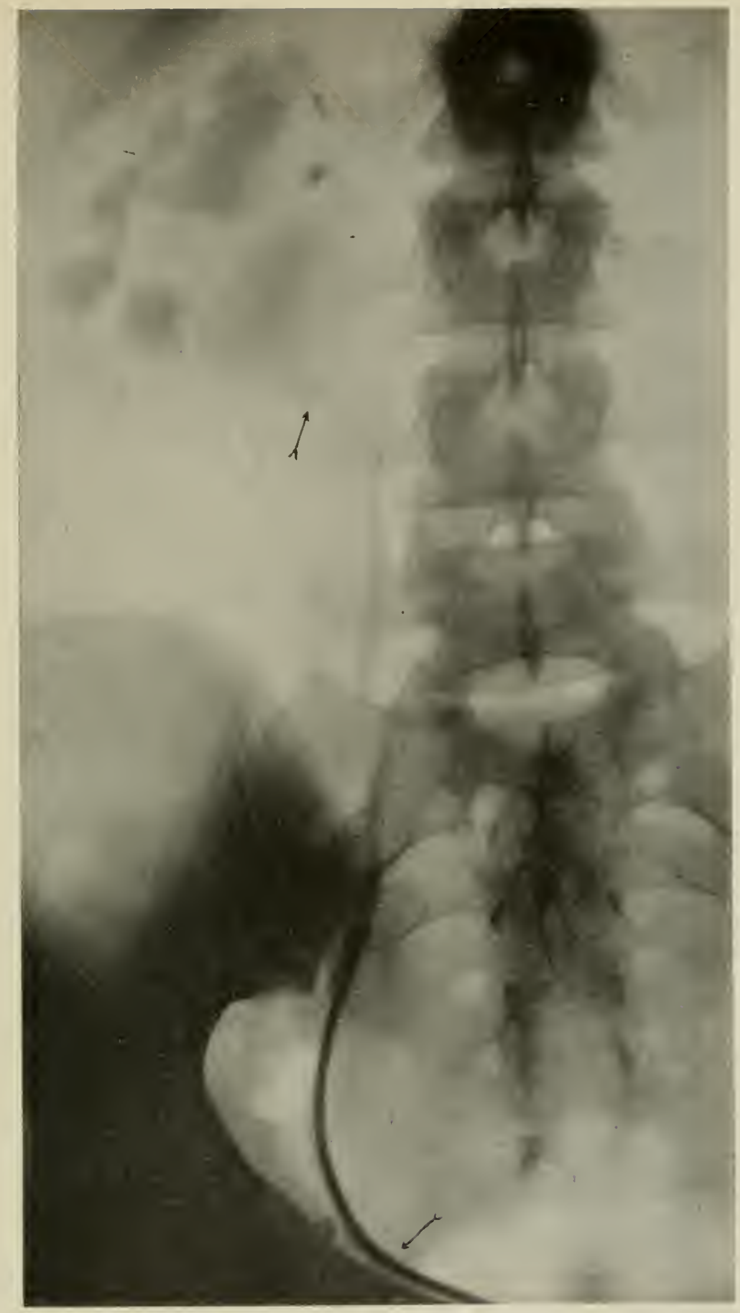

FIG. 13. ILLUSTRATING CASE 7; RIGHT PYELOURETEROGRAM

Note the widespread area covered by the pelvis which held only 12 cc. The catheter is withdrawn until the wax bulb, 10 cm. from the tip, has caught in the stricture area 2 cm. above the bladder orifice. Note the approximately normal ureteral lumen which has probably contracted during the patient's lumbar drainage and after the main point of obstruction became located at the upper end of the ureter. Note the dark spot at the ureteropelvic juncture probably indicating an end-on view of a short segment of ureter angulation. Note the venous phleboliths near the stricture region. The original x-ray film showed a shadow of kidney cortex about 2 mm. thick.

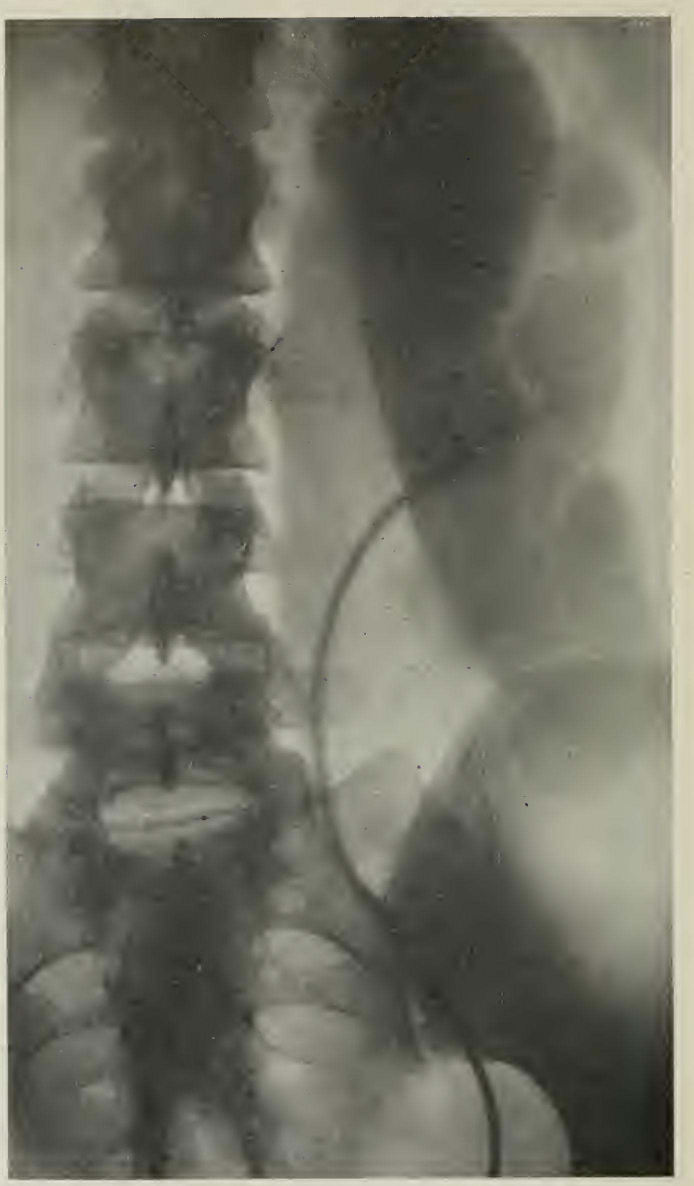

FIG. 14. ILLUSTRATING CASE 7; PYELOURETEROGRAM OF LEFT KIDNEY WITH INJECTION OF 150 CC. OF WATER FOLLOWED BY 75 CC. OF NABR.

Note the immense pelvis with indefinite outline and the masses of sodium bromide introduced with a 20 cc. syringe gradually being diffused through the water. Note the catheter apparently reaching to the outside of the middle calyx and the entire absence of knowledge presented by the pyeloureterogram as to the condition of the ureter and the mode of its entrance into the pelvis.

extension to empty into the upper ureter (figs. 15 and 16). A puncture wound was made in the posterior pelvis and a small mushroom catheter was placed in this to come out through the upper portion of the lumbar incision and safeguard the kidney drainage until we were certain of ureteral drainage. Through this we carried on daily irrigations of the kidney. While the patient was kept in the Trendelenberg position the mushroom catheter drained most of her urine. At the end of a week we allowed the ordinary prone position in bed with pillows and it was found that the bladder drainage increased. After removal of the mushroom catheter on the next day, the lumbar drainage tract closed at once, showing that the patient had free ureteral drainage.

The patient seemed to recover perfectly in every way, but after becoming active on her feet she began to develop obstruction symptoms. On January 25, 1922, X-rays were taken showing that the no. 9 renal plain catheter with wax tip and wax bulb was apparently obstructed with its tip caught in a ureteral loop at the ureteropelvic region (figs. 15 and 16). We encouraged the patient to go on shopping expeditions and for auto rides with friends in order to test her drainage thoroughly before allowing her to return home. On February 15, she became over-fatigued and the left kidney showed evidences of an almost complete obstruction, so we operated the second time on February 17. Under gas anesthesia we made a left semilunar line incision at about the mid-abdomen, and exposed the lower pelvis and ureter extraperitoneally. The kidney was retaining a firm fixation and it was not molested. The ureter was found to apparently enter the pelvis at the tip of the cone as pictured in figure 15 but on opening the pelvis the ureteral orifice was found located in the posterior wall of the cone 4 or 5 cm. from the apparent point of entrance, and the ureter was firmly adherent to the pelvic wall over this distance. Being anxious to avoid unnecessary disturbance to the ureteral circulation and to do as little operating as possible, I freed the ureteral adhesions and resected another small portion of the pelvis to further lift up the ureter end. I then placed a stiff male rubber catheter down the ureter and carried it out through the pelvis incision, and through the abdominal incision, hoping that by leaving the stiff catheter in the upper ureter for ten days the tissues would be set in a favorable position. Eyes were cut in the portion of catheter running through the pelvis to drain the urine either downward into the ureter or upward through the abdominal portion of the the catheter. A larger soft rubber drainage tube was telescoped over the male catheter and sutured into the pelvis to make certain of good drainage and an opportunity for thorough irrigation of the kidney.

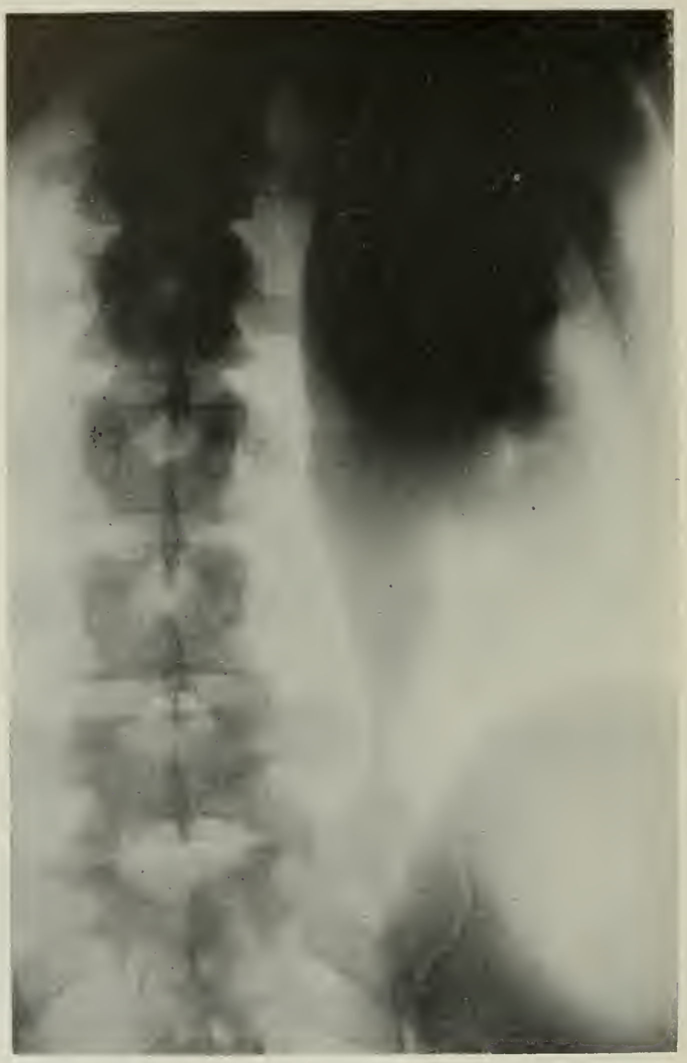

Fig. 15. Illustrating Case 7, after Resection of the Lower Two-Thirds of the Pelvis and Leaving a Cone-Shaped Extension of the Pelvis to Drain into the Ureter

Note the plain renal catheter apparently obstructing in the upper ureter. Note the slight dilatation of the upper portion of the pelvic ureter containing a slight amount of refluxed NaBr.

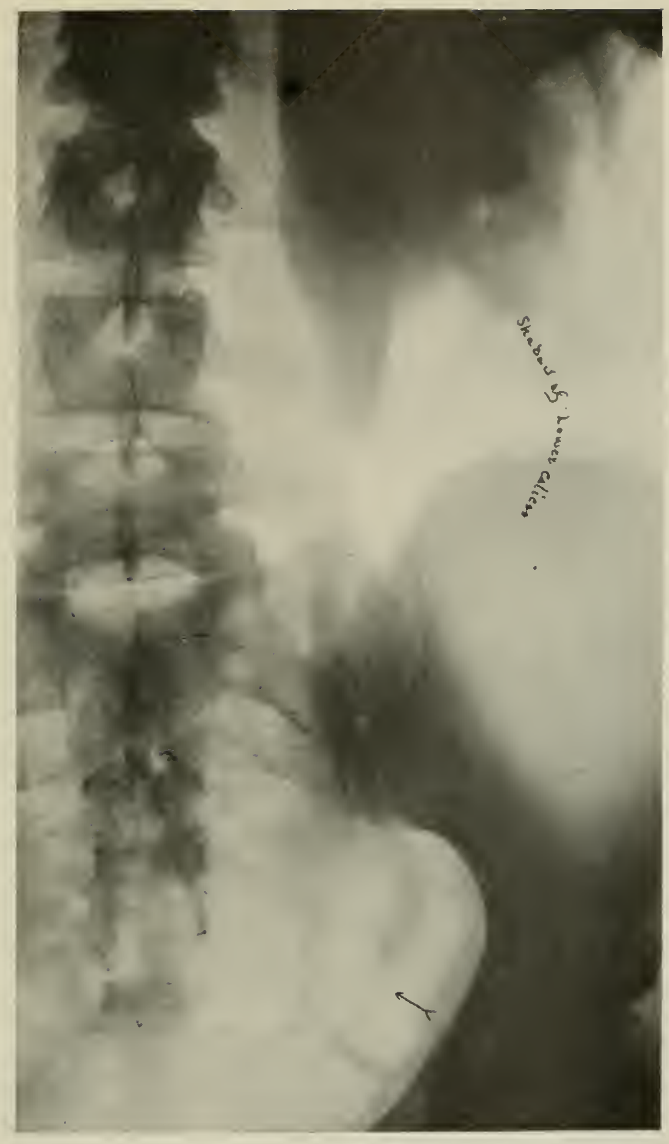

FIG. 16. TAKEN IMMEDIATELY AFTER FIGURE 15, ILLUSTRATING CASE 7

This plate taken after withdrawing the catheter until the bulb obstructed in the stricture area in about the mid-pelvis. Note the slight dilatation of the ureter above the stricture area, and the apparent whorl of the upper ureter before it enters the pelvis. Note the slow diffusion of the sodium bromide in the cul-de-sac formed by the lower calices after resection of the lower two-thirds of the original distended pelvis.

The patient made a prompt recovery but it became evident during her convalescence that the urine was not draining freely through the ureter. An x-ray (fig. 17) of the retained male catheter before its removal on the

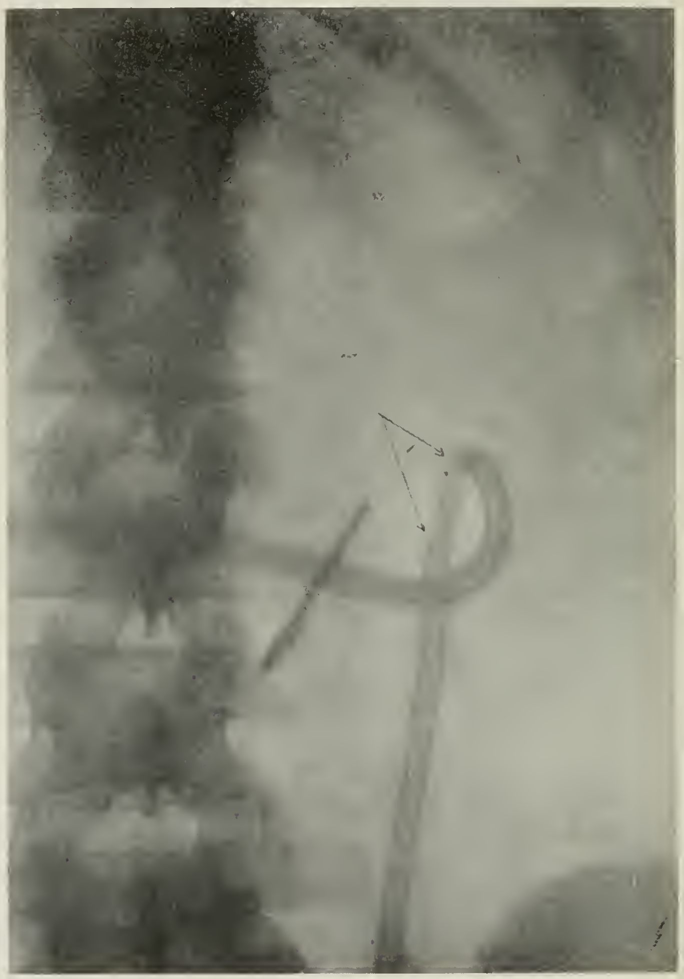

Fig. 17. Illustrating Case 7, Showing Male Rubber Catheter in the Upper Ureter and Coming Through the Pelvis and Out Through the Abdominal Wound, after the Second Operation

Note apparent compression of the rubber tube in the upper 3 cm. of the ureteral portion.

tenth day, shows a suggestion of constriction of the catheter in the upper 3 cm. of the ureteral portion. This indicated that we could anticipate a reformation of the pelviureteral valve after withdrawing the catheter, and suggested that it would probably have been better while the pelvis was opened in the second operation, to have introduced one blade of the scissors in the upper ureter, and to have freely incised the length of the ureteropelvic adhesions as illustrated in figure 18. When we found that the partial obstruction was persisting we decided to allow the patient to return home with a drainage apparatus which would insure free kidney drainage, and through which she could conveniently give the kidney daily irrigations (fig. 19).

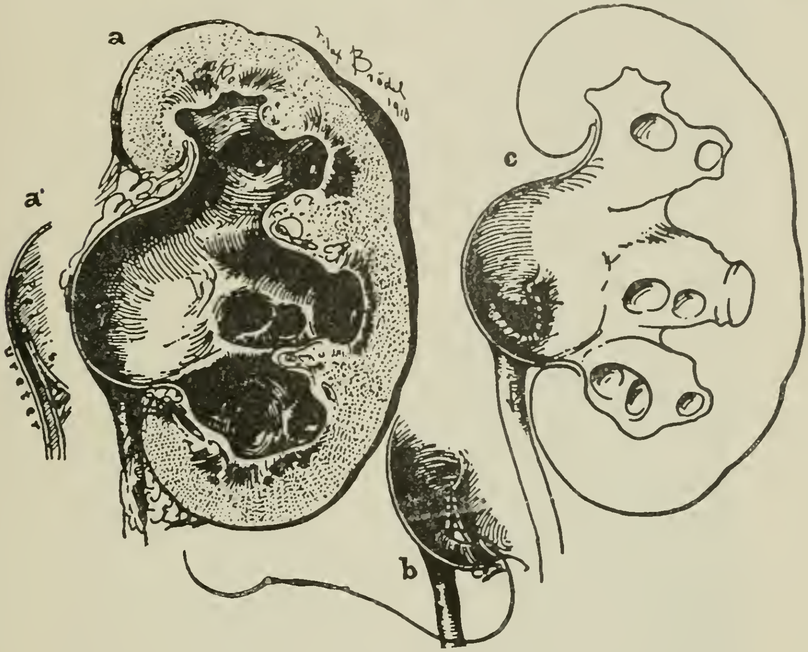

Fig. 18

Taken from Kelly-Burnam's "Diseases of the Kidneys, Ureters and Bladder" to illustrate a method of enlarging the ureteral opening in cases with valve formation often seen in hydronephrosis.

A phthalein test during her last week showed after intramuscular injection a two-hour output of 27 per cent as contrasted with the 17 per cent on admission.

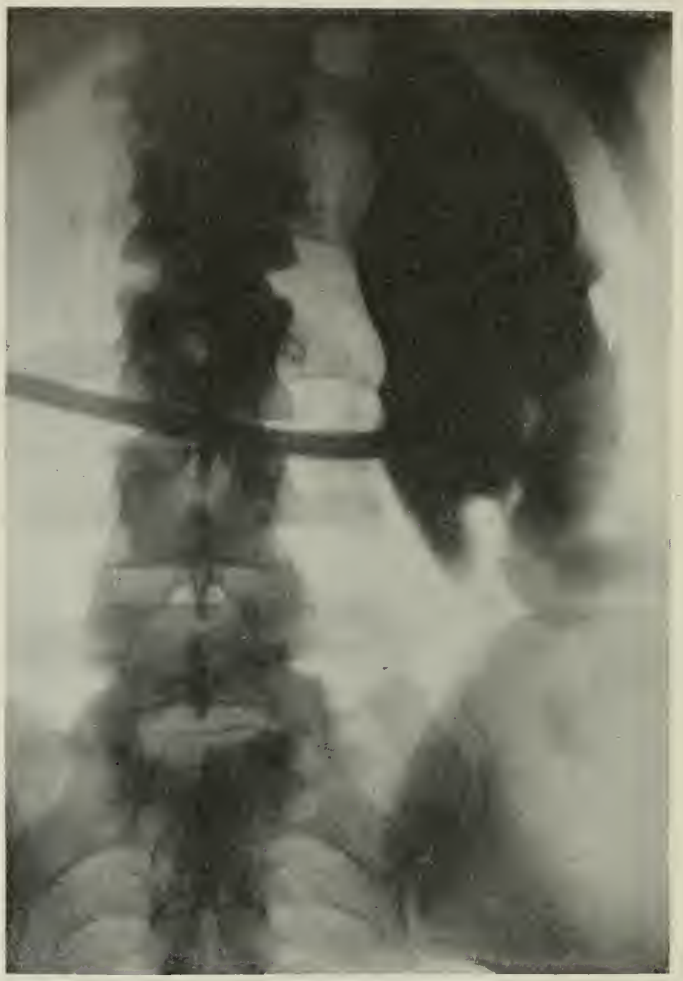

Fig. 19. Illustrating Case 7

Showing removable retention catheter in the kidney pelvis. The catheter leaves the abdomen in the left semilunar line and is held in position by passing through a slightly curved thin metal plate, which in turn is held in position by an elastic belt around the waistline. The catheter is connected with a rubber tube which leads downward under the corset to connect with a rubber urine bag swung inside the upper thigh.

Note the remaining upper portion of the kidney pelvis with the cone shaped projection below, which should show connection with the upper ureter if functioning properly. A later picture would probably have shown some drainage into the ureter for by the time the patient reached her room she passed sodium bromide from the bladder. Note the cul-de-sac formed by the lower calices.

A recent letter one month after her return home says that she has gained 10 pounds and has become quite accustomed to the care of her drainage apparatus, its inconvenience being quite compensated for by the relief from pain.

Case 8 (see figs. 20 and 21). Mrs. S., aged sixty-one years, referred April 8, 1921, by Dr. Julius Friedenwald. The patient had had bladder trouble for years, always having a feeling that she must void again immediately after emptying the bladder, and usually being up many times at night. On January 9, three months ago, she was taken severely ill in New York and the doctors thought she had gall-bladder trouble with mucous colitis. She had repeated spasms of pain in the upper right quadrant and much urinary frequency with these attacks. On her return home Dr. Friedenwald found that she had at times a large tender mass in the upper right quadrant, and that there was considerable pus and albumin in the urine.

On examination I found a tender mass filling the right flank and extending from beneath the costal margin to the lower abdomen opposite the anterior superior iliac spine.

On cystoscopy the bladder was normal and a no. 9 renal catheter with wax tip and small wax bulb passed to the right kdiney with one area of obstruction to the wax bulb after it entered the ureter. There was an immediate steady flow of 325 cc. of very dark amber urine appearing slightly bile colored. Tests for bile were negative. The kidney urine showed a specific gravity of 1015, acid, albumin ++, no sugar, no casts, many leukocytes, some erythrocytes. A subcutaneous phthalein injection showed in a one hour test: Right side appearance time twenty-six minutes, amount 53 cc., percentage not sufficient to read; left side, through bladder, time ten minutes, amount 138 cc., 28 per cent. On withdrawal the bulb showed a definite hang at a point 2 to 3 cm. above the bladder. The large mass completely disappeared and the right kidney was then found in a good high position and felt rather unusally firm for a hydronephrosis kidney. The patient had immediate relief from her pain and in the next few days her appetite improved and her mental condition and general well-being seemed to improve rapidly. On April 15, the mass again presented and on catheterization 200 cc. drained rapidly. We then introduced 50 cc. of iodide solution of 15 per cent strength and got the x-ray shown in figure 20. After withdrawing the catheter until the bulb hung in the stricture area we ran in an additional 45 cc. of the NaI and got figure 21. This

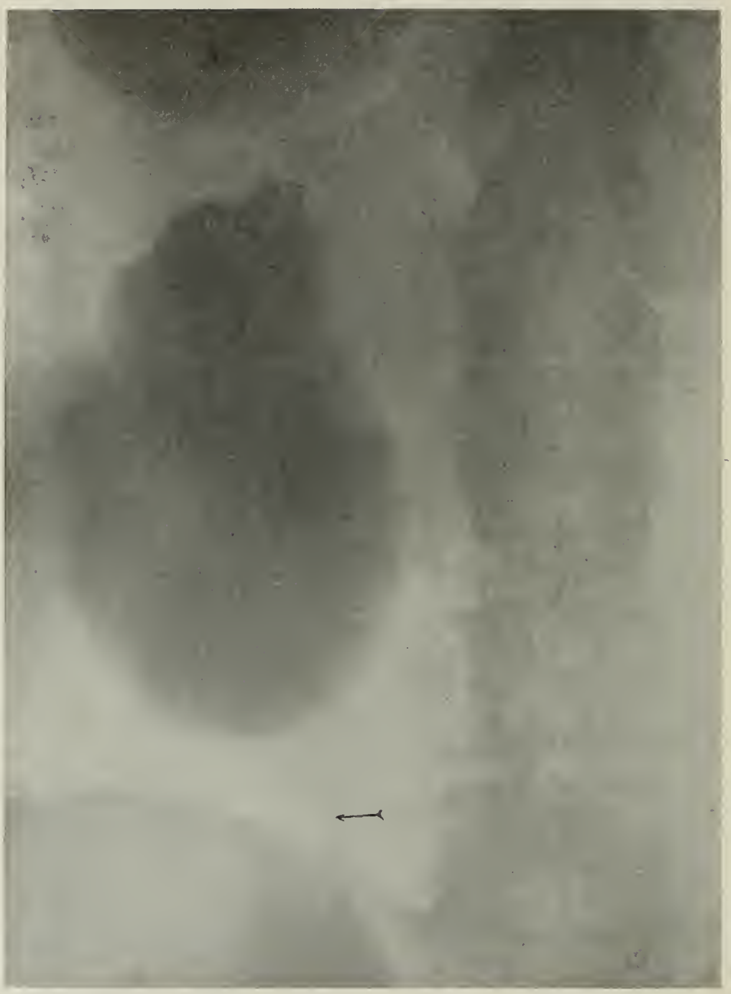

Fig. 20. Illustrating Case 8

Compare figure 21. Pyeloureterogram taken after withdrawng 200 cc. of urine and introducing 50 cc. of NaI. There must have been considerable residual urine to give such a large shadow. Note the trapping of the fluid in the kidney pelvis with no return flow along the catheter, thus preventing any conclusion as to the condition of the ureter.

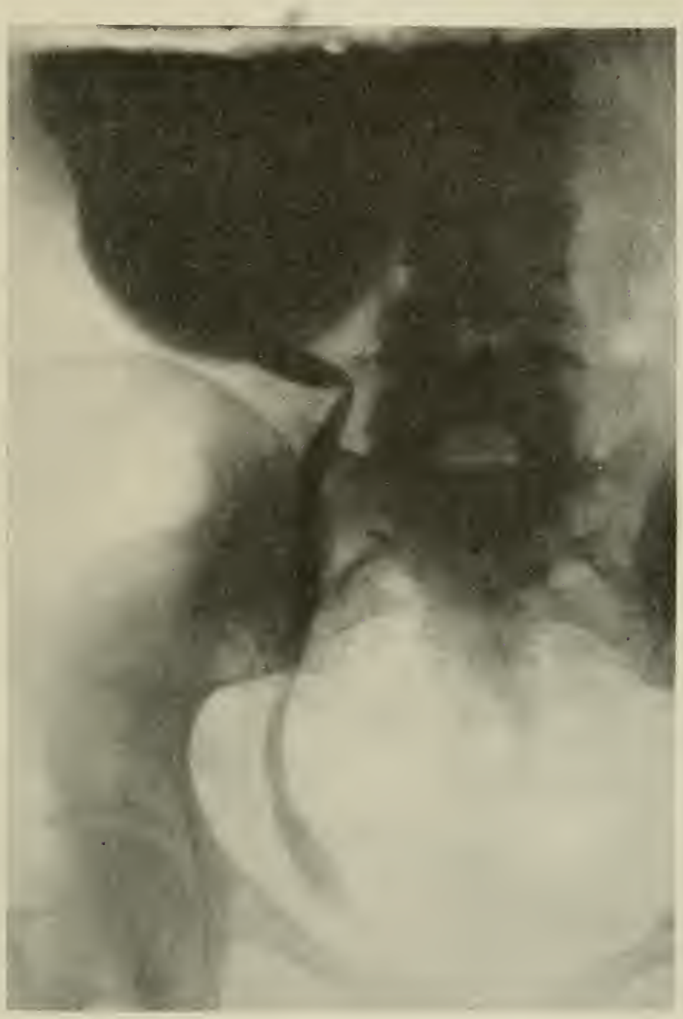

FIG. 21. ILLUSTRATING CASE 8

Taken immediately after figure 20, with the catheter withdrawn until the wax bulb hung in the stricture area, and with an additional injection of 45 cc. of NaI. Note the stricture area about 2 cm. above the bladder and the slight dilatation of the ureter as compared with the pelvis. No knowledge gained as to the nature of the ureter's entrance into the pelvis. Operation showed the upper ureter to have been held in a normal high position by adhesions, and to enter the immense kidney pelvis at its upper pole.

injection was apparently trapped in the kidney, for the mass in the side increased in size and tension and the temperature began to rise and reached 103°F. on the third day when the patient showed considerable toxemia and we felt obliged to operate.

At operation the kidneys was found to be of the elongate fetal type and to have an apparently normal amount of solid kidney cortex. In spite of the low phthalein output it would probably have come back to a good working capacity could it have been saved by plastic work. This was impossible, for the large pelvis was most densely adherent along the median aspect and to free it necessitated the exposure of the inferior cava and other large veins next to the back, and the hepatic flexure of the colon. The ureter was found to be about 6 mm. in its outer diameter, densely bound to the back by adhesions and connecting freely with the pelvis at its upper pole. The kidney was supplied with many accessory vessels arranged in two planes, an anterior and a posterior plane, and eight or ten of these were tied and cut before getting the kidney free.

The completed operation done largely under gas anesthesia took forty-five minutes and the patient's pulse seemed better after the operation than before.

The sequence of obstruction in this case was probably as follows: First, the ureteral stricture giving rise to hydronephrosis and hydroureter; second, a lateral compression of the upper ureter by the enlarged pelvis. It is possible that sagging of the kidney played a rôle in the secondary obstruction because of the high fixation of the upper ureter, but the kidney itself could not sag markedly because of its double row of fetal vessels, and because of the dense adhesions of the posterior face of the pelvis.

The remaining kidney secreted from 1000 to 1500 cc. of urine daily after the operation. The temperature was normal the morning after operation and remained so for several days. The pulse rate was in the eighties and nineties. Twenty-four hours after operation the patient began to have twitching of the hands and later of the feet, this becoming rather excessive in the next twenty-four hours. At the end of forty-eight hours we suspected that this might mean iodoform poisoning and we therefore replaced with two plain gauze wicks the four wick drains which had been left in the kidney wound with about 1 inch of the iodoform gauze exposed at the end of each wick. By the end of the third day the patient was mentally restless and at times irrational and we called various consultants for examination of the blood and excreta and the consensus of opinion was that it was a case of iodoform poisoning. After ten days the patient seemed to be recovering but on the twelfth day, while being propped up on pillows, she suddenly died apparently of heart failure.

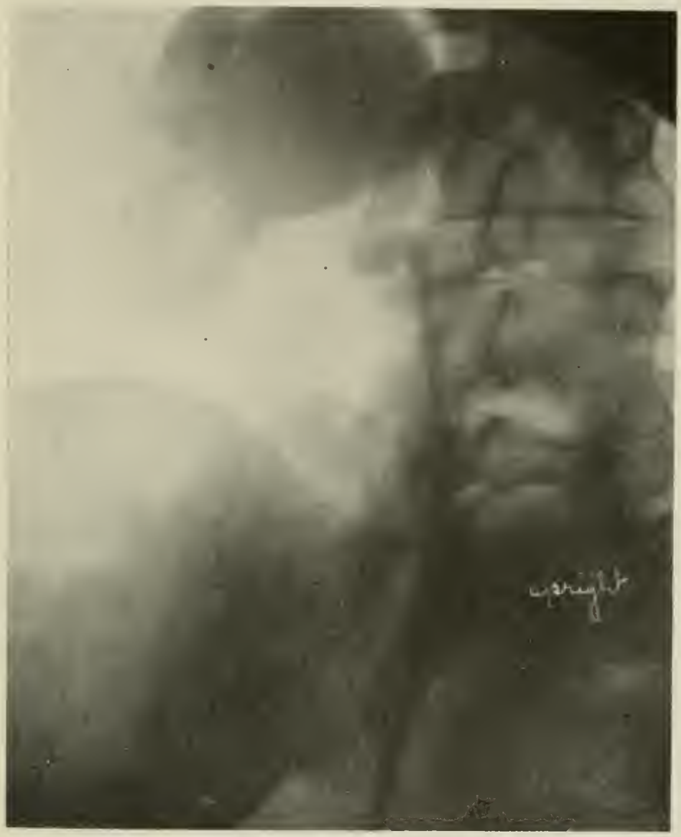

Fig. 22. Illustrating Case 9

Note the fairly large ureter and the relatively larger kidney pelvis. Note the harmless "kink" below the kidney, and the upper end of the ureter apparently hitched up beside the pelvis. At operation the obstruction was found to be due to pressure across the upper ureter by the infiltrated perirenal capsule which was adherent to the back and acted as a suspensory ligament, drawing the pelvis toward the spine and compressing the ureter. For this pyelogram the pelvis took only 20 cc. of the sodium bromide but it must have had residual urine, for the pelvis appears to have a capacity of between 30 and 40 cc.

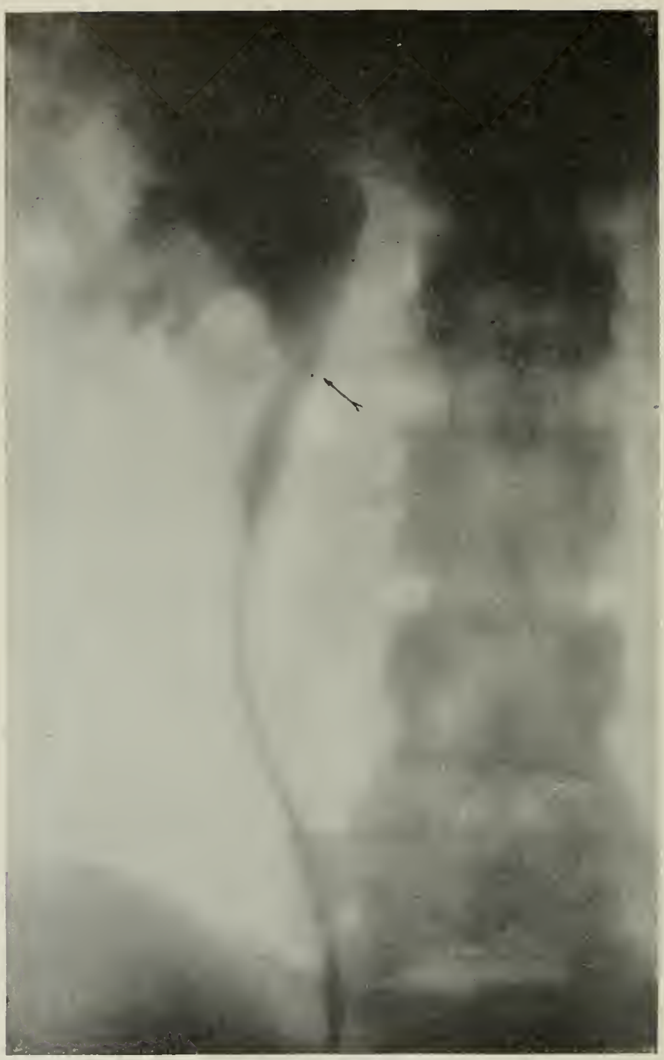

Fig. 23. Illustrating Case 10

This pyeloureterogram taken with the patient in the prone position with an injection of 25 cc. of NaBr solution illustrates the third type of x-ray showing relatively wide dilatation of the ureter with the development of some form of obstruction at or near the pelviureteral junction. Note the dark area at the pelviureteral junction as if showing a segment of angulated ureter.

Case 9 (see fig. 22). Mrs. C., aged thirty-four years, had been seen occasionally for six years because of bilateral ureteral stricture. During her first pregnancy and puerperium she had pyelitis in her right kidney and during her second pregnancy the left kidney was similarly affected.

The left ureter had but one dilatation and the right ureter had had several treatments. The pyelitis cleared up promptly from each kidney after giving better ureteral drainage, but the patient was most active and remained very thin, and whenever her vitality was low the right kidney was the seat of much pain. She had become dependent on morphin and her medical advisers thought best to perform nephrectomy. The operation is briefly discussed in the text.

Case 10 (see fig. 23). Mrs. W, aged thirty years, referred by Dr. John Neff, University of Virginia, because of the persistence of severe pain in the kidney region even after he had thoroughly dilated a stricture area located a few centimeters below the pelvic brim. The patient was daily demanding frequent hypodermics of one-fourth grain of morphin.

Pyeloureterogram (fig. 24) suggested a secondary obstruction near the kidney. At operation, with a catheter in the ureter, we filled the pelvis and found that an S loop developed in the course of the upper ureter, and that as the pelvis became full it exerted a lateral pressure against this loop, shutting it off in spite of a relatively wide lumen at this point of about 6 mm. diameter.

The above cases have been selected as showing some of the extreme conditions met with in ureteral stricture work.

We have had a number of patients with as large hydronephroses and apparently even more serious infections, in which restoration to sterile urine and good function were obtained after simple dilatation of the stricture with the establishment of good drainage.

On the other hand, we have had to operate on patients with pelvic dilatation much less than that represented by the above cases, because dilatation of the stricture failed to give good drainage, the dilated pelvis together with mobility of the kidney giving rise to secondary kinks, traction bands, and lateral pressure in the kidney region.

In practically all of the patients belonging to this category of ureteral stricture with secondary hyrdonephrosis, dilatation of the stricture results in much improvement as seen by the lessening of pain, especially while the patient is lying down, by a shrinkage in the pelvis content, by an improvement in the kidney function, and, in kidneys with infection, by a decided clearing up of pus and bacteria. Some of the resistant cases become pus free, but if there is secondary blockage in the kidney region sufficient to cause symptoms, a slight bacilluria is apt to persist.

I have been much interested in the above and many additional similar cases in trying to interpret their value as pyeloureterogram studies. Most urologists are still basing their opposition to my ideas concerning the frequency of ureteral stricture on two arguments. First, they hold that if a no. 5 or 6 renal catheter enters to the kidney without appreciable obstruction there can be no stricture. I use nothing but nos. 7, 8 and 9 catheters in treating adults, and I should estimate that in at least two-thirds of all stricture cases these large catheters show no appreciable obstruction going in until the wax bulb meets the stricture area.

Their second contention is that a diagnosis of stricture must not be made unless the pyeloureterogram shows decided changes in the upper tract. As a matter of fact, with the wax-bulbed catheter one can get fairly accurate measurements of the upper tract content, can study the functional capacity of the kidneys, and locate the number and character of the strictures, and what is more to the point, can give most stricture patients the desired relief from symptoms without the use of the X-ray. In the past the X-ray has been of more harm than value in diagnosing ureteral stricture. This, however, is not the fault of the method, but of our interpretation of the pictures.

In the group of patients under discussion one can see by the illustrations that the X-rays are at least of some value in carrying conviction to those who might be inclined to doubt the statements concerning the capacity of these kidneys.

I have hoped that by a study of many pyeloureterograms we might come to some valuable conclusion concerning the nature of the secondary obstructions near the kidney, so as to arrive at an early prognosis, and be able to tell the patient at once whether dilatation of the ureteral stricture will give complete relief or whether a future operation will probably be necessary. The results of this study to date have not been as fruitful as one might wish. One valuable conclusion is that, in general, from the pyeloureterogram viewpoint, there are three groups of patients with hydronephrosis due to ureteral stricture. In the first group are those showing relatively equal dilatation of the ureter above the stricture and of the kidney pelvis, and also apparent angles in the ureter situated a few centimeters below the kidney (see figs. 1 to 5). These are the formidable "kinks" over which urologists have been stumbling for some years past and for which many kidneys have been submitted to needless operations.

It is highly satisfactory to be able to tell a patient belonging to this group that the only treatment required is thorough dilatation of the stricture to establish good drainage.

In the second group of patients are those showing a ureter without "kinks," in other words, an apparently straight ureter which appears to enter the kidney pelvis abruptly near its lower border. These ureters may show no evidence of dilatation because the shadowgraph material becomes trapped in the kidney and fails to return along the catheter (see figs. 7, 9, 10, 14, 15, and 20). Such a pyeloureterogram may be entirely misleading as to the real condition of the ureter; and in these cases it becomes necessary to withdraw the catheter until the wax bulb hangs in the stricture area, and then inject a small quantity of shadowgraph material while getting a second x-ray (see figs. 8, 16 and 21).

In this group of cases we are fairly safe in promising the patient that she will improve under the stricture treatment, but that she may need operation before complete relief is obtained.

I have a number of patients in this group who, after the stricture treatment, have become free from symptoms, although some still show leukocytes and bacteria, and others who suffer so little inconvenience that they prefer not to have an operation. Whether the relatively slight dilatation of the ureter as pictured in this group means that the obstructing forces secondarily developed in the kidney region have become so predominant that they release the ureter in large measure from its back-pressure due to the stricture, and whether the ureter was formerly much larger and has undergone shrinkage after the secondary obstructing forces in the kidney region have become predominant, are questions of at least speculative interest.

Our third classification from the pyeloureterogram view point includes the borderline cases apparently belonging between the first and second groups. In these we have a fairly widely dilated ureter above the stricture area, and a relatively greater dilatation of the pelvis. The ureter may show the harmless "kinks" a few centimeters below the kidney indicating that there has been a tendency for the ureter to prolapse with the kidney. In contradistinction, however, to what is seen in the first group, the ureter is not entering broadly into the lower end of the kidney pelvis, but is apparently hitched up beside the pelvis; or there is a deepening of the X-ray shadow just at the junction of the pelvis and ureter, suggesting an end-on view of an angulated segment of the upper ureter (see cases 9 and 10, figs. 22 and 23). Clinically, these patients may respond promptly to dilatation of the stricture, but on the other hand they may get very little benefit, and at operation we find various factors producing an obstruction in spite of the tendency of the upper ureter to prolapse with the kidney.

The fascia binding the upper ureter to the back may have failed to lengthen with the prolapse of the kidney and thus have formed a sharp angle at the ureteropelvic junction. The perirenal capsule may have become thickened, relatively shortened and bound to the posterior abdominal wall by previous pyelitis attacks, and by failing to prolapse as rapidly as the kidney it compresses the upper ureter, as in case 9 (fig. 22). Very slight bands of fibrous tissue following pyelitis attacks may tie the first 1 or 2 cm. of the ureter to the kidney pelvis so as to cause lateral compression and kink with even slight overfilling of the pelvis (see fig. 11, case 6). In a recent case the prolapsing ureter had developed an S loop so near the pelvis that filling of the comparatively small pelvis of 25 cc. capacity at the operation was seen to result in a lateral compression of this loop. There were no accessory bands to be cut and high fixation of the kidney was all that was indicated (see fig. 23).

In thin patients in groups 2 and 3 who respond favorably to the ureteral stricture treatment but who do not get entire relief, one should not overlook the valuable therapeutic measures productive of an increase in fat to help to fix the kidney. Several weeks of absolute rest in bed with the head low, and forced feeding are measures that will supplement the ureteral stricture treatment and help in avoiding operation in some of these cases. Many patients even without special measures take on fat rapidly after the dilatation of the stricture, and this probably aids in ultimate cure in some cases in which, judging from the pyeloureterogram, one would predict an operation.

It may be of value to the beginner in this work to add several points of practical interest bearing on the diagnosis that one learns by experience.

It is safer to use salt solution or water for the first investigation of a kidney pelvis, for if the fluid becomes trapped in the kidney, the patient will not have such a severe reaction as when some antiseptic solution has been used.

One can usually tell if the catheterized kidney is hydronephrotic because of the steady flow, immediately after the introduction of the catheter, of an amount of urine beyond the normal 7 to 8 cc. Exceptions occur when the renal catheter for any reason has not reached the kidney pelvis. In such a case an enlarged pelvis with overdistension may kink or compress the upper ureter so as to produce anuria. Often one can get such a pelvis to empty itself through the ureteral catheter by changing the position of the patient. Have the patient take the knee-breast posture, or elevate her hips while she remains in the dorsal position, or takes the lateral position, and one can often get the kidney to shift its position in such a way that the ureteral kink is straightened or the compression is relieved and the urine can get out of the pelvis.

Another exception that may lead to a misinterpretation in a case of possible hydronephrosis is found in the rare instances of a practically continuous flow from the kidney when a nervous patient has been drinking a large quantity of water. In such doubtful cases if an injection be made to the point of pain, when normal, the pelvis will respond after the usual injection of 5 to 10 cc. Before making such an injection test one must first allow the steady flow to continue for some time in order to drain a possible hydronephrosis. If one makes the injection before a hydronephrosis has been partially drained, it may take only a few cubic centimeters again to distend the overfull pelvis to the point of discomfort.

Whenever the shadowgraph fluid becomes trapped, the patient should not be returned to bed or sent from the hospital until the kidney has been drained. If this cannot be accomplished by changing the posture while the catheter is still in the lower end of the ureter, the catheter should be removed and a fresh one should be introduced right into the kidney pelvis and left there until the fluid is completely evacuated. At times one finds it impossible to introduce a second catheter because of inflammatory swelling blocking the catheter in the stricture area, or the tip may easily pass the stricture area and yet fail to get by the angulation in the kidney region. Under such circumstances the patient usually suffers a severe reaction, but occasionally the kidney seems to drain soon after the catheter is out and the reaction is only slight.

The surprising fact is that the overfilled pelvis eventually does become freed. When overfilled with urine in the ordinary routine of life, or overfilled by our attempts to get the pelvis capacity, or to get a pyelogram, one would think that the tendency would be for the pelvis to become more firmly blocked, and even go on to rupture. It is probable that the intrarenal pressure quickly stops further secretion and that changes of position between the kidney and the upper ureter eventually lead to drainage, but the more one studies at operation the various angles, bands, valves, and lateral pressures involved in these cases, the more one marvels how complete blockage can ever be spontaneously rectified.

In operating on these hydronephrosis cases it is well to make a generous incision in order to free the kidney easily with the least possible trauma, and to enable one to make a systematic study of the conditions obtaining about the pelvis and upper ureter. Such studies are made most illuminating by following Kelly's method of passing a renal catheter before operation, and after exposure of the renal field filling the pelvis to various degrees of distension. One should never completely fill the pelvis at operation for fear of injury to the kidney substance. The indwelling catheter often facilitates exposure of the ureter at the beginning of the investigation.

Our experience with the surgical aspects of these cases is too limited to warrant dogmatic conclusions as to the value of the work or as to the best methods. In estimating the value of such work one's first question is: "Why try to save such kidneys?" This has been answered in the case-histories presented. A low functioning hydronephrotic kidney giving disabling pain, especially if it be infected, should be removed, providing the opposite kidney and ureter are normal or promise to do good work after the ureter has been treated. This has been my practice. In the above cases the kidney operated upon was the only functioning kidney in case 7, and it was the better functioning kidney in cases 1 (not operated upon) and 4 and in case 6 the bad kidney was seen to be slowly recovering after the ureteral treatments. In case 5 there were two dense strictures and a low phthalein output on the better side, and we operated on the right side with the idea of removing the kidney if it appeared too badly implicated. It appeared to have so much good kidney tissue that we considered it justifiable to try to save it even with a second operation. The end results seem to have verified our opinion. In case 9 both ureters had strictures, both kidneys had been the seat of a puerperal pyelitis but had become free from infection, and the phthalein output was good and equal on both sides. I feel fairly confident from considering the conditions at operaiton that the kidney could have been saved by severing ureteral adhesions and performing a high fixation, but it was the opinion of her medical advisers that it would be unwise to leave any chance for future pain because of the patient's dependence on morphin.

In dealing with a mechanism as delicately balanced as is the ureteropelvic junction, and particularly when that mechanism has been badly disarranged by disease, one hesitates to lay down hard and fast rules. Each case differs from the preceding one in the problems presented and the surgeon should approach these problems with an open mind, ready to adopt the course that seems best suited for the individual case. I have briefly described the procedures adopted in each operation with the reasons for them. Further experience should develop new methods and possibly in time some valuable rules. In general, I have thought it wise to avoid resection of the ureter because of its blood supply and to avoid trauma to the delicate tissues. On the other hand, most of these ureters have become enlarged and thick-walled because of the stricture at the lower end, so that we are dealing with conditions differing vastly from those associated with normal ureters. Experience may prove that the circulatory conditions are adequate and that we do less trauma in some of these cases by resorting to an end-in-pelvis anastomosis than by trying various plastic methods.

The question of drainage arises in dealing with many of these cases. In general one would think it would be better to omit post-operative drainage, for our chief aim is to avoid post-operative adhesions about the ureteropelvic region. On the other hand, when there is a thin-walled cortex and an infection of the pelvis, one hesitates about using permanent suture material for fixation of the kidney, and it becomes a question whether to trust entirely to the fixation obtained by using the capsules of the kidney, or to establish drainage down to the kidney pelvis with the object of stimulating adhesions which will assist in holding the kidney in its high position.

By following this latter method in case 6 we seemed to get the desired ideal result, whereas in the first operation in case 5, in which we closed without drainage and trusted one linen suture through the cortex and the use of the perirenal fascia as additional factors of support, the patient had a return of symptoms; and at her second operation we found that there were very dense adhesions binding the upper several centimeters of the ureter to the back. Her second operation in which drainage was established has apparently been followed by an ideal result.

Perhaps you may ask me whether one surgical rule approximating universal application has been developed by dealing with more than 1500 ureteral stricture patients. At present I can only adduce one: In proposing to operate on a patient with ureteral stricture never take anything for granted. In each case take a careful history, make a thorough bilateral examination, even though the symptoms may be unilateral, and then weigh all the facts obtained before deciding upon the treatment.

ACCIDENTAL BILATERAL OCCLUSION OF THE URETERS[1]

LEON HERMAN
Philadelphia, Pennsylvania

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Bilateral occlusion of the ureters is an extremely rare accident in pelvic surgery. The purpose of this paper is to place on record the case history of a patient upon whom a double deligation was performed successfully; to collate those cases reported in the the literature, and to draw therefrom such conclusions as seem reasonable in the light of our present lack of experience.

CASE HISTORY

Mrs. E. C., aged twenty-one years was admitted to the Methodist Episcopal Hospital of Philadelphia on April 25, 1921, complaining of bleeding from the vagina. The patient stated that she had missed her menstrual period in February, 1921, and believing herself to be pregnant, had inserted a hair-pin into the uterine cavity. This was followed by bleeding which continued for eight days. Clots and "pieces of tissue" were passed. On April 23, the bleeding reappeared and two days later, she presented herself for treatment. The bleeding was at no time excessive and the patient's general health seemed to be excellent.

For seven or eight months prior to admission, she had had pain and tenderness in the lower left abdomen which had gradually increased in severity. There was no history of vaginal discharge other than the bleeding.

On examination, it was found that there was slight bleeding from the uterus, the latter organ being enlarged but not pregnant. A large, tender mass was palpable in the region of the left broad ligament; the right broad ligament was tense but not indurated. The uterus was fixed in position. The diagnosis of chronic tubo-ovarian inflammation with pelvic peritonitis was made and operation advised.

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On April 29, 1921, Dr. Richard Norris did a supravaginal hysterectomy. This proved to be a difficult operation on account of extremely dense and widespread adhesions, so that the uterus was amputated higher than usual (subtotal hysterectomy). Considerable difficulty was encountered in controlling the hemorrhage.

The immediate post-operative course was uneventful except for the fact that no urine was voided; and after ten hours it was determined by catheter that the bladder was empty. Further catheterizations were equally non-productive and forty-eight hours after operation, the writer was asked to see the patient by Dr. Markley Albright, Dr. Norris having been called out of town the previous day. Dr. William R. Nicholson, Dr. Albright and the writer then examined the patient and all agreed that the probabilities were that the ureters had been occluded by ligatures. It was decided to examine the patient cystoscopically and if the ureters were found to be obstructed, to explore the pelvis.

Operation. Forty-eight hours after the hysterectomy. Dr. Herman, assisted by Drs. Albright and Hall. Cystoscopy under local anesthesia. "Bladder wall, especially in the region of the outlet, very edematous and swollen; marked distortion of the proximal portion of the urethra. Both ureteral orifices flaccid, and stand gaping, wide open. No peristalsis can be seen, the ureters being apparently atonic. No urine can be seen coming from the ureters and indigo-carmine injected intravenously, does not appear from either ureter after a period of eighteen minutes. Each ureter is obstructed to catheters at points 2 inches from the bladder."

The catheters and cystoscope were removed, and it was decided to explore the pelvis. The patient was etherized and placed in the Trendelenburg posture. A lower left rectus incision was made extending from the pubes to a point 1 inch below the level of the umbilicus. This incision was made parallel with the original incision and about 1½ inches distant from it. The attempt was made to expose the left ureter extraperitoneally but the friable peritoneum was soon broken through and entrance made into the peritoneal cavity. The preperitoneal tissues were infiltrated with blood and serum, especially in the region of the bladder base. No urine was detected. The peritoneal incision was enlarged and it was found that the sigmoid on the left, the cecum on the right and coils of small intestine in the center, were adherent to the operative area in the pelvis. These structures were easily mobilized and packed away with large gauze packs.

The pelvic tissues were markedly thickened, the excessive amount of exudate present having destroyed all semblance to normal anatomy. The pelvic peritoneum had been destroyed in great part and the stump of the uterus was buried in the mass of exudate but was easily outlined by touch.

Having previously determined that the point of obstruction was above the normal point of contact of the ureter and uterine artery, the usual place of accidental ligation of the ureter, and knowing that a subtotal hysterectomy had been performed, it was decided not to attempt to expose the lowermost segment of the tube by dissection in the region of the lateral portion of the bladder base, but to search for it on the side wall of the pelvis lateral to the stump of the uterus. Accordingly, the tissues were separated by blunt dissection to the left side of the uterine stump and the ureter, dilated to about the size of the little finger, was easily exposed. This tube was then freed downward toward the bladder and lifted from its bed of exudate until an obstruction was met with in the form of a catgut ligature. The point of obstruction was well above the normal site of the main trunk of the uterine artery. The ureter had been ligated apparently in attempts, either to control bleeding from the ovarian artery, to control bleeding from an ascending branch of the uterine artery, or from accidental ligation of the latter in the effort to close the opening in the broad ligament. The ureter was aspirated with a fine hypodermic needle and clear fluid was obtained. The ligature was then removed after cutting it with small blunt pointed scissors. After the removal of the ligature, we were not sure that there was not a second obstruction lower down; a small incision was made therefore, in the longitudinal axis of the tube through which a considerable quantity of clear fluid escaped; this fluid contained no trace of the indigo-carmine which had been injected about one-half hour previously. A blunt pointed probe was passed into the ureter through the minute incision and thence into the bladder and upward toward the kidney pelvis. Having demonstrated the freedom of the tube from further obstruction, the incision in the ureter was closed with a single suture of plain catgut.

The right ureter was found in a manner similar to that just described but with even greater ease for the reason that its upper pelvic portion was dilated to the size of an adult's index finger and strong peristaltic waves could be seen passing in a downward direction to the point where the tube entered the mass of exudate where the contraction waves were arrested, and whence started reversed peristaltic waves which could be seen as plainly traveling from below upward, the two actions giving to the ureter a peculiar snake-like action.

A minute incision was made in the ureter through the intact peritoneal covering and a probe passed toward the bladder until an obstruction was met with. Using the probe as a lever, the ureter was lfted out of the mass of exudate which surrounded it, and the obstructing ligature thus brought plainly and easily into view. The ligature was cut and removed but on attempts to pass the probe into the bladder, a second obstruction was encountered 1 inch distant from the site of the first one. This proved to be a second ligature which was also removed, whereupon the probe entered the bladder. The incision in the ureter was then closed with a single stitch of catgut.

Small rubber tubes were placed in the region of either ureteral incision for drainage and the intestines coffer dammed from the operative area with a large piece of rubber tissue.

While the wound was being closed, and with the patient still in the Trendelenburg position, the cystoscope was again introduced and catheters passed to the kidney pelves. The instrument was then removed, leaving the catheters in situ. The catheter in the right ureter began at once to discharge blood-tinged fluid; the left catheter did not function while the patient was in the operating room. No indigo-carmine was seen either in bladder or coming from the catheter. We feared lest the catheter on the left side had passed into the peritoneal cavity through the ureteral incision, but it was decided not to reopen the wound to determine this point.

The operation lasted one hour and the patient left the table in excellent condition. An intravenous injection of salt solution completed the procedure.

Post-operative course. At 10 p.m. of the night of operation (nine hours after operation) it was noted that the right catheter was draining freely, the fluid being slightly tinged with blood. The left catheter had not functioned at all. The dressings were saturated with serum but no odor of urine could be detected. One hour later (ten hours after operation), the patient voided. Next morning, the patient stated that she had voided frequently during the night and that it was impossible to retain it. The right catheter had drained freely and continuously during the night. Next morning 2 ounces of clear urine was obtained from the bladder by catheter. There was no leakage of urine from the incision. Aside from slight lower abdominal distention, the patient's condition was excellent. The temperature was 101⅗, the pulse 110. During the first twenty-four hours, 21 ounces of urine was obtained from the right catheter; the urine from the left kidney was passed involuntarily. On the third post-operative day, the drainage was 28 ounces; 9 ounces were passed voluntarily and a considerable quantity was passed involuntarily. The temperature had now become practically normal while the pulse showed some variations in rate. The amount of urine voided gradually increased and on the fifth day, the drainage was only 5½ ounces while 31 ounces were voided voluntarily. The incontinence had practically ceased. The catheter was now removed from the right ureter, the left one having been removed on the second day after operation, having been functionless throughout.

The convalescence was uneventful; the wounds healed promptly and at no time was there any leakage of urine.

On the day of operation, the blood content of urea nitrogen was 32 mgm.; two days after operation it was reduced to 25 mgm. per 100 cc. At this time, the leucocyte count was 8990. Three weeks after operation, the 'phthalein output was 30 per cent for the first hour and 20 per cent for the second hour. The patient was discharged from the hospital in excellent condition twenty-seven days after the second operation.

Three months later, she returned for cystoscopic examination. It was then found that the bladder was normal. The urine was normal in every respect and sterile. The ureteral orifices were slightly relaxed, especially the right one. Catheters, size 6 F, were passed to each renal pelvis and normal urine obtained from each kidney. There was no evidence of dilatation of either ureter or renal pelvis. The function of the kidneys was normal and equal with 'phthalein and we could find no abnormality, either anatomical or functional, of the urinary tract, with the exception of slight relaxation of the ureteral sphincters, while the normal intermittent peristaltic action of the ureters as observed cystoscopically indicated that these muscles were continent. The patient was last seen several months ago and is in pesect health. In view of the findings after operation we did not feel justified in making pyelograms although we were sorely tempted to do so. In the entire absence of symptoms or abnormal findings, we could not convince ourselves of the justification for this procedure.

In reviewing the operative steps in this case, we feel that certain modifications in technic might be advantageous. Indwelling ureteral catheters might have obviated the necessity for the second introduction of the cystoscope, although it might be difficult to remove the cystoscope and leave catheters in ureters obstructed near their terminals; the catheters would almost certainly be displaced under these circumstances during the withdrawal of the instrument. The instrument could, of course, be kept in the bladder during the operation without great danger of traumatic injury. In this instance, there was not the slightest difficulty in catheterizing the ureters with the patient in the Trendelenburg posture and this step did not add to the time of operation.

Our associates were somewhat doubtful of the wisdom of making incisions into the ureters, but had we not done so, the second ligature on the right ureter would not have been discovered until the catheters had been reintroduced, nor could we have been certain that either ureter was patulous. It is evident that these minute ureteral incisions healed promptly and completely. The introduction of the probe and its use as a lever is of the greatest assistance in lifting the ureter from its bed in the localization of the obstructing ligature or ligatures. This same principle might be used to advantage in the extra-peritoneal removal of small stones situated at the uretero-vesical junction. Drainage could not be dispensed with safely in cases of this kind, but gauze in the form of cigarette drains or otherwise should be avoided.

FREQUENCY

In 1902, Sampson contributed one of the comparatively few exhaustive papers on the surgery of accidental injuries to the ureters. This paper included the report of 32 ureteral injuries that had occurred in the Johns Hopkins Hospital, all of them being unilateral injuries; up to the time of this report, no instance of accidental bilateral ureteral occlusion had occurred in this hospital.

Sampson collected 6 instances of bilateral occlusion from the literature, and it may be presumed that a careful search was made.

In 1912, Barney again reviewed the literature and made inquiry among the prominent surgeons of the country with the result that a collection of 30 cases of ureteral injury was made. To these, he added the 32 cases reported by Sampson. To the 6 cases of bilateral occlusion mentioned by Sampson, 10 additional cases were added, but unfortunately, the detailed description of these cases was omitted, so that they are not available for statistical study.

H. Kayser mentions 29 cases of primary and secondary injuries to the ureters, and quotes Wertheim as having had 49 among 500 operations (10 per cent) for carcinoma of the uterus, in none of which were both ureters occluded.

G. G. Smith has had 2 cases of bilateral ureteral ligation; Deaver, Norris, Hirst and Davis of Philadelphia, men of wide surgical experience have each had 1 case.

In a recent paper on uretero-ureteral anastomosis, Peterson quotes 72 instances of ureteral injury, the vast majority of which were unilateral injuries discovered and repaired during the primary operation.

Werder had 4 instances of ureteral injury which occurred during a series of 1500 celiotomies; in 1 instance one ureter was cut and its fellow of the opposite side ligated.

From the foregoing quotations, it is evident that bilateral ureteral occlusion is extremely rare, and we feel gratified to be able to present a series of 24 cases with sufficient data to enable us to draw certain conclusions regarding the treatment of this interesting surgical complication.

TYPES OF BILATERAL URETERAL OCCLUSION

In 15 (62.5 per cent) of the 24 cases herewith reported, the occlusion was due to encircling ligatures; in 2 instances, the ureters were kinked and completely obstructed as the result of the traction of ligatures which latter did not, however, encircle them.

Pelvic exudate following the application of the Percy cautery completely obstructed both ureters in 2 cases. In 2 instances, the ureters were caught in vaginal clamps. A segment of one ureter was removed with a pelvic tumor, the other being occluded by kinking in a case reported by Markoe and Wood. In Werder's case, the right ureter was severed, the left one ligated.

SYMPTOMS

Anuria

Sudden, complete anuria is characteristic of double ureteral ligations and bilateral clampings. After operation, the patient may void urine that was contained in the bladder prior to the receipt of the ureteral injury. One of Smith's patients voided 7 ounces, then 1 ounce and then no more. The second patient voided 8 ounces and then no more. Our own patient did not void and no urine was found in the bladder.

Complete bilateral obstruction following Percy cauterization may be sudden and complete as happened in Pinkham's case, or there may be a period of anuria followed by the secretion of small quantities of urine for a brief period with recurrent and continuous anuria as happened in the case reported by Fishel.

Anuria must be differentiated from suppression of urine, the most important surgical causes of which are shock and nephritis. There are, in addition, certain rare causes which must be taken into account, such as the so-called reno-renal reflex, an interesting example of which is mentioned by Barney. In this instance, unilateral ureteral ligation was followed by death from uremia after thirty-six hours. The cause of death was given as reflex suppression of urine in an uninjured kidney succeeding injury to the ureter of the opposite side, but no mention is made of cystoscopic or post-mortem examination to determine the presence of the supposedly healthy kidney.

Robinson divided and ligated the left ureter, and so exposed the right one that its injury was impossible. When the patient subsequently developed suppression of urine, he exposed and decapsulated the right kidney; the patient recovered.

W. P. Graves found it necessary to remove a segment of the left ureter with an immense adherent adeno-fibrocystoma; the right ureter was exposed but not injured. Urinary suppression followed the operation but was recovered from spontaneously after thirty-six hours.

The incidence of acute suppression of urine following unilateral ureteral injury is said by Barney to be 1.6 per cent. The practical point to be borne in mind in connection with this group of cases is the necessity for cystoscopic exploration of the ureters unless one can be sure that one ureter is not obstructed or only temporarily obstructed.

Anuria is usually the only symptom referable to the ureteral injury in bilateral cases during the early stages of the obstruction. This, as has been pointed out by many observers, is in contrast with unilateral injuries which give rise, in many instances, to loin pain on the affected side, on the opposite side or bilaterally. One of Smith's patients, seen seventy-two hours after double ligation, complained of pain in the back, while pain over both kidneys was complained of by the patient of Professor Davis. Our patient was entirely free from subjective symptoms, and with the exception of anuria and a slight increase in the blood urea nitrogen content, was to all appearances, making an unusually uneventful convalescence from a serious pelvic operation.

Uremia

Aside from the question of the possible restoration of renal function after varying periods of ureteral obstruction, there remains the clinical consideration of uremia from the diagnostic and prognostic standpoints. The time of onset of uremic symptoms in cases of bilateral occlusion differs widely, in some instances appearing promptly, in others only after the lapse of several days. In 6 of our collected series, uremic symptoms complicated the clinical picture, the shortest appearance time having been noted by Smith in a patient who had general distress and vomiting within twenty-four hours of the receipt of the injury. As was to be expected, Caulk's patient (eight days) and Pinkham's patient (seven days) had unmistakable evidence of uremia.

Uremia could scarcely be looked upon as an important diagnostic symptom complex in ureteral injuries, the accidental occurrence of which should be recognized long before the onset of the systemic evidence of renal failure.

The presence of uremic symptoms is ordinarily of evil prognostic significance, but in the present series all of the patients with signs of uremia recovered.

RESULTS OF BILATERAL OCCLUSION

The obstructed ureter has little tendency to open without operation and we know of no instance of bilateral occlusion that was relieved spontaneously. Our series contains only 1 unoperated case (Caulk) and this patient died of uremia. No doubt some patients with bilateral ureteral occlusion have died without operation, the condition being mistaken for urinary suppression. There is, nevertheless, a remote possibility that the ligature may cut through, or that the ureter may rupture proximal to the point of ligation and form a uretero-abdominal or uretero-vaginal fistula. This has never occurred, so far as we know, in a case of double ligation, but 2 instances of intraperitoneal rupture of the ligated ureter (single ligations) are recorded, 1 by Frankel, the other by Blumenfield; both patients died of peritonitis.

Of great practical importance is the possibility of the spontaneous restoration of ureteral function after the removal of obstructing clamps. In Hirst's case, the flow of urine was immediately restored after the clamps were removed. Dr. Hirst answers our query as to the probable nature of the obstruction, as follows: "I think you are quite right in assuming that the ureters were kinked and not actually compressed by the clamps. That was the opinion I had of the case because the urine evacuation was immediately resumed, also there was no fistula." Neuman was not so fortunate in his case in which the temporary restoration of normal urinary function after removal of the clamps was followed by the development of a fistula.

In 2 cases, Furniss accidentally clamped the ureter during supravaginal hysterectomy, in both instances the clamp was on from seven to eight minutes and in both instances fistulae developed, one in eight days, the other after twenty days. The ureter had been dissected free for a distance of 3 cm. and Furniss concludes that in cases where the ureter has been dissected free and clamped it would be better to do an immediate uretero-vesical anastomosis. Bilateral anastomosis is indicated in his judgment, when both ureters are thus injured although he has not had occasion to perform the double operation.

Kayser mentions 7 cases in which only the sheath of the ureter was injured and of these, 2 developed fistulae. The prognosis in cases of this kind is more favorable than when the ureter is completely severed or crushed. This is shown in the illustrative example of a woman who developed a uretero-vaginal fistula six days after an abdominal hysterectomy. This patient was referred to us several weeks after the development of the fistula when it was found that the left ureter was obstructed to catheters 4 cm. from the bladder, although clear urine was obtained from the catheter in the normal intermittent spurt. The lower segment of the ureter showed the normal peristaltic wave which is absent in cases of transverse section and ligations of the ureter. The right ureter was patulous and normal. Indigo-carmine injected intravenously appeared from the right catheter in three minutes; from the left catheter and from the vaginal fistula it appeared in a much less intense concentration in six minutes. Not a drop of urine came away per vaginum after the ureteral catheterization and the patient was discharged from the hospital a week later in perfect health and has since remained well, although we have not had the opportunity to make further cystoscopic examinations. In this instance, the uretero-vaginal fistula had been caused in all probability by a needle used in the first operation. We find that the spontaneous closure of ureteral fistulae after single catheterizations is not uncommon, even in cases where it is impossible to pass the catheter through the strictured area.

Notwithstanding the probability of fistula formation following the application of clamps in vaginal hysterectomy, it would seem better to remove the clamps and await developments, rather than to attempt the immediate operative restoration of ureteral continuity. Should anuria continue after the removal of the clamps, the operation of choice would seem to be uretero-vesical anastomosis. Should fistulae develop, the operation of colpocleisis must be given due consideration, but it has been suggested that the danger of continued contraction of the fistulous opening after the vaginal segment has been turned into the bladder will result eventually in complete destruction of the kidney. This has not been proved absolutely, and the results in some cases would seem to refute the theoretical objections, but a successful uretero-vesical anastomosis would undoubtedly have certain advantages over a successful colpocleisis.

The results of experimental clamping of the ureter are quite at variance with those observed clinically. In contradistinction to the conclusions of Furniss that accidental clamping of the ureters is so serious as to necessitate immediate uretero-vesical anastomosis, are the results of an experimental study reported by Harrington. This investigator exposed and crushed the ureters of dogs with the Kocher forceps for a period of from one to thirty minutes. The injured ureters were then replaced behind the peritoneum.

The results of these experiments led Harrington to draw the following conclusions:

1. Injury to the ureter by crushing forceps causes degenerative changes at the point of application, resulting in the formation of scar tissue which produces a partial constriction that may later progress to complete stricture.
2. There is dilatation of the ureter and pelvis in most instances which may progress to the point of hydronephrosis and degeneration of the kidney.
3. No leakage of urine follows the application of a clamp to the ureter.

It has been shown experimentally by Barney and others, that the uninfected ureter may be divided intraperitoneally in many instances without fatal results. The majority of such injuries in humans results in uretero-abdominal or uretero-vaginal fistulae, and the fatalities are few. The crushed ureter of the dog which is carefully replaced behind the peritoneum, as Harrington has shown, usually becomes obliterated, whereas in humans after hysterectomy, extravasation of urine occurs and the urine finds exit by way of the abdominal or vaginal incisions.

Various clinical observations do not justify the conclusion that freeing the ureter alone has a vital influence in the formation of fistulae due to necrosis of the ureteral walls. Stewart and Barber have shown conclusively that stripping the ureter of its nerves, blood vessels and lymphatics from the pelvis of the kidney to the bladder causes ureteral paralysis, while Harrington has proved that no pathology results in either the kidney or the ureter, if the blood supply alone is preserved. Freeing the ureter incidental to operations on the pelvic organs might reasonably be expected to interfere to some extent with the blood supply and thus enhance the danger of necrosis, should clamps be applied to the mobilized segment.

METHODS OF TREATMENT, PRIMARY MORTALITY RATE AND ULTIMATE PROGNOSIS

The method of operative or other treatment, selected for the relief of bilateral ureteral obstruction will depend upon the cause of the obstruction, upon the individual preference of the operator, and possibly, to some extent, upon the time interval that has elapsed since the receipt of the injury. It will depend also upon the presence or absence of certain complicating factors in connection with the primary pelvic operation.

Bilateral ureteral occlusion following the application of the Percy cautery to the malignant cervix and presumably dependent upon the pressure of extra-ureteral exudate, would seem to furnish an indication for ureteral catheterization. In neither of the reported instances, however, could catheters be passed beyond a point 2 cm. from the bladder. Fishel chose double nephrostomy in his case with the result that while the patient's life was spared, ureteral patency was never restored. Pinkham did a double uretero-vesical anastomosis with excellent results. Uretero-vesical anastomosis has never been performed, so far as we know, for bilateral ligation of the ureters. Kronig reports 2 successful cases of implantation, but it is not stated if the operation was done primarily, or for the relief of ureteral obstruction. The operations of Smith were performed after double nephrostomy had been done unsuccessfully.

There are very good reasons for believing, as we have already stated, that the application of vaginal clamps to the ureters causes necrosis with ultimate fistulae formation. It may be that the clamps merely cause angulation of the ureters without actually compressing them in certain instances. This seems to have been the case in Hirst's patient in whom the normal urinary function was immediately restored after the removal of the clamps.

The obvious treatment of obstruction by clamps is removal of the clamps, which will, however, be followed in the majority of instances by fistulae. The treatment of the latter does not concern us here, suffice it to say that colpocleisis has been performed successfully by Neumann and others, despite the oft-repeated assertion that the false ostia will continue to contract with eventual destruction of the kidneys.

The majority of cases of accidental bilateral ureteral occlusion are instances of ligation, or of kinking, due to the application of ligatures in the region of the ureters. The surgeon must decide in cases of this kind whether to attempt deligation or some other form of operation on the ureters at the site of ligation, or to relieve the urinary stasis by bilateral nephrostomy, or pyelostomy. Operations other than deligation and nephrostomy have been performed so rarely, that figures are not available for statistical study.

As regards double nephrostomy, Caulk has made the following statement:

> In double ligations, your only chance is to do a double nephrostomy as quickly as you can. The ideal method would be immediate deligation, but this is attended with considerable difficulty as searching for a tie on a ureter deep in the pelvic cavity several days after an extensive resection is difficult. Even in animals it is difficult to untie without cutting the ureter. In several instances in which I have known of its being done clinically, the ureter has been incised with a resulting fistula or a uretero-vesical anastomosis performed at the time.

Caulk was led to these conclusions by an experience with an extraordinarily good result following double nephrostomy in a very poor surgical risk. The patient had had complete ureteral obstruction for a period of eight days; she was uremic and the result from double nephrostomy, which not only saved the patient's life, but restored completely ureteral function, could scarcely be improved upon. Caulk's conclusions were further fortified by a series of animal experiments, the results of which indicate the probability that nature will restore the lumen of the dog's ureter ligated with catgut, if renal drainage is applied.

The arguments for bilateral nephrostomy as advanced by Caulk are most convincing, and we would be inclined to accept them as final, did our statistics not show that Dr. Caulk's patient is the only one that has ever recovered completely after double nephrostomy. E. S. Judd mentions a case in which bilateral nephrostomy was performed in a woman who had had anuria for three days, with spontaneous restoration of ureteral function seven days after the operation. We feel justified in taking exception to Judd's conclusion, namely that "in this case the ureters had both been ligated with catgut, though the lumen was restored as soon as the catgut was absorbed." Caulk and others have shown experimentally that plain catgut is not absorbed before the end of the third week, and that waiting for this event to take place in double ligations is futile.

We are inclined to believe that the obstruction in this instance, was not due to encircling ligatures, but to kinking and inflammatory swelling upon the subsidence of which the ureters opened spontaneously. This is, of course, mere conjecture, but there are so many cases in which the ligated ureter failed to open after nephrostomy and the spontaneous opening of the ureter in Caulk's case was so long delayed, that we are inclined to look upon Judd's case as an exception which does not justify the conclusion that the ureters opened by virtue of the absorption of the catgut.

We have collected 10 cases of bilateral ureteral obstruction in which double nephrostomy was performed; nine of these were double ligations, and 1 followed the application of the Percy cautery to a malignant cervix. One (10 per cent) (Caulk's case) of these recovered with spontaneous restoration of normal ureteral function. If we accept Judd's case, there were 2 (20 per cent); 5 (50 per cent) died as the result of the nephrostomies, and the 3 remaining patients recovered from the operation, but the ureters failed to open. Of these latter 3 cases, 1 (Fishel's case) died as the result of cancer several months later, while 2 (Smith's cases) were cured by bilateral uretero-vesical anastomosis.

These statistical facts would seem to condemn nephrostomy as an exceedingly dangerous, and rarely successful method of treatment in cases of accidental bilateral ureteral occlusion.

The condition of the ligated ureter observed by Smith in 2 reoperated cases is most instructive. Nature had failed in these instances to restore ureteral continuity and it was necessary to do uretero-vesical anastomosis in order to close the fistulae in the loins. The ureters were exposed in the first patient twenty-two days after the nephrostomies had been done and it was found that "the ureters had been thinned down to mere cords; on the left side just a fibrous cord existed between the two ends of the ureter; in the right ureter, a narrow lumen persisted." The advocates of nephrostomy will contend that sufficient time had not elapsed to permit nature to restore the ureteral lumen after the manner described by Caulk. In answer to this, we would quote the findings in Smith's second case, in which the ureters were exposed three months after nephrostomy, and in which it was found that these tubes were totally obstructed and buried in a mass of adhesions.

From clinical experience, we must conclude that spontaneous restoration of the lumen of the ligated ureter after nephrostomy is exceedingly rare.

The primary mortality of operations undertaken to correct accidental bilateral occlusion of the ureters was found by Barney to have been 33.3 per cent in his collected series of 16 cases. In our series of 23 operated cases, there were 7 deaths, a primary mortality of 30.4 per cent. The primary mortality among the 10 nephrostomy cases was 50 per cent; among the 8 cases of deligation, it was 25 per cent. All of the patients, 6 in number, who recovered from the operation of deligation were cured

TABLE 1

Deligations

REPORTER	TIME	NATURE OF INJURY	UREMIA	OPERATION	RESULT
Zweifel	48 hours	Bilateral ligation	No	Left ureter deligated, 48 hours; right ureter deligated, 6 days	Recovery
Herman	48 hours	Bilateral ligation	No	Bilateral deligation	Recovery
Davis	36 hours	Bilateral ligation	No	Bilateral deligation	Recovery
Dorff	48 hours	Bilateral occlusion due to kinking from ligatures	No	Bilateral deligation	Death (autopsy negative)
Purcell	58 hours	Bilateral occlusion due to kinking from ligatures	Yes	Bilateral deligation	Recovery
Martin	48 hours	Bilateral occlusion due to clamps and ligatures	No	Bilateral deligation	Death in 24 hours from peritonitis
Barney	48 hours	Bilateral ligation	(?)	Bilateral deligation	Recovery
Deaver	48 hours	Bilateral ligation	(?)	Bilateral deligation	Recovery

Primary mortality—25 per cent; complete recoveries—75 per cent.

TABLE 2

Bilateral nephrostomies

REPORTER	TIME	NATURE OF INJURY	UREMIA	OPERATION	RESULT
Fishel	48 hours	Exudate following Percy cautery	Yes	Bilateral nephrostomy	Recovery but ureters did not function
Chute	56 hours	Bilateral ligation	No	Bilateral pyelostomy	Death—72 hours
Smith	72 hours	Bilateral ligation	Yes	Bilateral nephrostomy; ureteroplasty; uretero-ureteral anastomosis	Recovery but ureters did not reopen. Cured by operations on ureters
Smith	24 hours	Bilateral ligation	Yes	Bilateral nephrostomy; bilateral uretero-vesical anastomosis	Recovery but ureters did not reopen. Cured by secondary operation
Tenney	(?)	Bilateral ligation	(?)	Bilateral nephrostomy	Death—48 hours
O'Neil	48 hours	Bilateral ligation	(?)	Bilateral nephrostomy	Death
Caulk and Fischer	8 days	Bilateral ligation	Yes	Bilateral nephrostomy	Recovered. Ureters functioned—58 days
Judd	72 hours	Bilateral ligation	(?)	Bilateral nephrostomy	Recovered. Ureters functioned—7 days
Barney	96 hours	Bilateral ligation	(?)	Bilateral nephrostomy	Death—48 hours
Barney	48 hours	Bilateral ligation	(?)	Bilateral nephrostomy	Death—24 hours

Primary mortality—50 per cent; complete recoveries—20 per cent; recoveries without ureteral function—30 per cent.

TABLE 3

Miscellaneous

REPORTER	TIME	NATURE OF INJURY	UREMIA	OPERATION	RESULT
Neuman	72 hours	Occlusion by vaginal clamps	No	Removal of clamps; colpocleisis for fistula	Recovered after secondary operation
Hirst	36 hours	Occlusion by vaginal clamps	(?)	Removal of clamps	Recovered
Markoe and Wood	48 hours	Segment removed from one ureter; other occluded by kinking	No	Deligation of one ureter; uretero-ureteral anastomosis on opposite side	Recovered
Werder	15 hours	Right ureter severed; left ureter ligated	No	Deligation and uretero-vesical anastomosis; colpocleisis	Recovered after secondary operation
Pinkham	7 days	Occlusion by exudate following Percy cautery	Yes	Bilateral uretero-vesical anastomosis	Recovery
Caulk	Details lacking. Died without operation				

promptly, completely and permanently. One of the fatalities (Martin's patient) following deligation, resulted from peritonitis, but in this instance, clamps had been applied and in all probability the ureters had been both clamped and ligated. In fact, no mention is made other than this of injury to the ureter during attempts at deligation.

The comparative statistics just given relative to the comparative safety and efficiency of deligation as contrasted with nephrostomy would justify certainly the adoption of deligation in the majority of instances; if the figures are interpreted absolutely literally, the condemnation of nephrostomy is inevitable. We cannot condemn with entire justice, however, a procedure that has resulted so satisfactorily in the case of Dr. Caulk, notwithstanding the fact that this is the only recorded instance in which it has so happened.

Nor do we feel justified in advocating deligation to the exclusion of all other methods, such as uretero-vesical anastomosis. Markoe and Wood deligated one ureter and made an end in end anastomosis on the opposite ureter with complete success. Werder deligated one ureter and implanted the other one into the bladder but a uretero-vaginal fistula followed the operation.

The writer feels that a careful analysis of the cases herewith reported will justify the conclusion that the operative method of choice in cases of accidental bilateral occlusion of the ureters due to ligatures embraces transperitoneal exposure of the ureters at the site of injury and deligation, or if this proves to be impracticable, uretero-ureteral or uretero-vesical anastomosis.

One might hesitate to reopen an abdomen and attempt deligation in a patient whose convalescence from the primary operation was complicated by peritonitis; nephrostomy is to be preferred too in the presence of symptoms strongly suggestive of pyelonephritis.

The objections to deligation on technical grounds are largely unfounded. Each writer in turn warns against the danger of hemorrhage following the removal of a ligature which encircles both the ureter and the artery. Aside from the fact that this has never actually occurred, the probabilities of its occurrence are exceedingly slight and should it occur at the time of operation, its control would be a relatively simple matter.

Caulk refers to the unusual difficulties of deligation; those who advocate the method have found it comparatively simple.

Our advocacy then of deligation is based on the following facts: (*a*) the primary mortality (25 per cent) following deligation is lower than that following nephrostomy (50 per cent); (*b*) the final results are far better with deligation than with nephrostomy (deligation 75 per cent of complete cures; nephrostomy 20 per cent of complete cures) and even if the patient recovers after nephrostomy, the convalescence is prolonged, tedious and disagreeable (in Caulk's case, the ureters reopened on the fifty-eighth day after nephrostomy and the patient was confined to the hospital for a period of four months) and (*c*) notwithstanding the evidence obtained by animal experimentation, which would tend to prove that Nature will eventually restore the ureteral lumen after ligation with catgut in cases treated by nephrostomy, the clinical evidence absolutely refutes this with the exceptions already noted. From this clinical study, we must conclude therefore that: (*a*) Delay in the operative treatment of accidental bilateral ureteral occlusion is always dangerous and will eventually result in death; (*b*) that the longest period of complete obstruction with recovery following operation on record is eight days (Caulk's case); (*c*) that no one method of operation is applicable to all cases; (*d*) that deligation is the method of choice; (*e*) that nephrostomy is a dangerous and rarely successful operation; (*f*) that obstructing clamps should be removed but with the expectation that fistulae will develop.

CASE HISTORIES

Bilateral nephrostomies

1. Fishel, B. Woman, thirty-nine. Carcinoma of uterus. *Primary operation:* November 23, 1915, cervical mass cauterized (Percy cautery) with hand in pelvis to gauge degree of heat. Cauterization continued for one hour. Broad ligaments infiltrated, and pelvic lymph nodes palpably enlarged.

Post-operative course: On December 2, 1915, only 7 ounces of urine voided; December 3, 1915, complete anuria; during succeeding twenty-four hours passed 9½ ounces after the application of hot packs, cups to loins, etc., December 10, 1915, patient drowsy.

Cystoscopy: Bladder empty; ureters obstructed to no. 6 F. catheters at 2 cm.

Secondary operation: Double nephrostomy; both kidneys greatly congested and twice the normal size.

Result: Kidneys drained freely until March, 1916, when the patient died of carcinoma. The ureters did not reopen.

2. Chute, A. L. *Primary operation:* Hysterectomy, double ligation of the ureters.

Secondary operation: Continued anuria for forty-eight hours; double pyelostomy.

Result: Death after three days.

3. Smith, G. G. Woman, forty. *Primary operation:* December 27, 1917, supravaginal hysterectomy.

Post-operative course: Passed 7 ounces of urine, then 1 ounce and then no more. Examined by reporter seventy-two hours after primary operation. Complained at that time of pain in the back and vomiting.

Cystoscopy: Normal bladder; both ureters obstructed to catheters at 8 cm.

Diagnosis: Bilateral ligation of the ureters.

Secondary operation: Bilateral nephrostomy. The pelves were first opened and then drained through counter incision in the renal cortex. The incisions in the pelves were not sutured.

Post-operative course: On January 21 (twenty-two days after nephrostomy) the ureters were found to be totally obstructed; no urine had come away per urethram. It was then decided to expose the ureters in the pelvis.

Third operation: Ureters exposed above the points of ligation through Gibson incisions. A mass of adhesions was found and the "ureters were thinned down to mere cords; on the left side just a fibrous cord existed between the two ends of the ureter. In the right, a narrow lumen persisted. A ureteroplasty was done on the right side and a uretero-ureteral anastomosis (method of Soresi) on the left side.

Post-operative course: The nephrostomy tubes were removed on the sixth day. A catheter was left in the left ureter for six days. On February 14, all wounds were healed. The "next summer," the patient had an attack of right-sided renal pain but catheterization of the ureter showed no abnormality "so far as the ureter was concerned."

Result: Recovery after third operation.

4. Smith, G. G. *Primary operation:* Hysterectomy for cancer, January 3, 1918.

Post-operative course: On January 4, 1918, at 7 p.m. she was in general distress and vomiting. Eight ounces of urine voided and then no more.

Cystoscopic examination: Areas of retraction in the bladder above each ureter. Ureteral catheters obstructed on each side at about 1 cm. above the meatus.

Secondary operation: Bilateral nephrostomy.

Post-operaiive course: The patient was fairly comfortable with the tubes in the loins but the ureters failed to reopen. Three months later, she was again operated upon.

Third operation: Spinal anesthesia and light ether. Transverse suprapubic incision. Peritoneum torn in attempts to free it from the bladder. Ureters freed and dissected downward toward the bladder near which they were lost in a mass of adhesions. Ureters cut across just above the inflammatory mass. Bladder opened and found to be clean. Double uretero-vesical anastomosis. Nephrostomy tubes removed.

Post-operative course: In the summer of 1918, the patient returned and stated that the left nephrostomy wound had opened and closed intermittently since the operation. Right side had closed promptly and permanently.

Cystoscopy: Left ureter end hanging loose in bladder; impossible to catheterize. Patient died of recurrent cancer in November, 1918.

Result: Improved after the third operation.

5. Tenney. *Primary operation:* Hysterectomy. Bilateral ureteral ligation.

Secondary operation: Bilateral nephrostomy.

Result: Continued anuria; death in forty-eight hours.

6. O'Neil. *Primary operation:* "Abdominal operation."

Post-operative course: Anuria for forty-eight hours.

Second operation: Bilateral nephrostomy.

Result: Death.

7. Caulk and Fischer. *Primary operation:* January 18, 1915, hysterectomy for large fibroid.

Post-operative course: Complete anuria for eight days; evidence of uremia on the seventh day.

Secondary operation: Bilateral lumbar nephrostomy. Both kidneys enlarged, hydronephrotic and congested.

Post-operative course: Patient immediately rallied; kidneys secreted promptly, the left one 87 ounces during the first twelve hours. Patient ran an intermittent fever and the urine became "dirty." On the fifty-eighth day after operation, urine was voided normally and ten days later, the nephrostomy wounds were healed. The kidney function was extremely low to 'phthalein. She was "about ready to leave the hospital" on May 18, 1915 (hospital residence about four months). Attempts to dilate the ureters failed.

Late results: "She is now (1920) in excellent health and her renal function has returned to normal limits." The details of the functional studies are not stated.

8. Judd, E. S. *Primary operation:* Total hysterectomy for extensive carcinoma of the cervix.

Post-operative course: Anuria for three days.

Secondary operation: Bilateral lumbar nephrostomy.

Post-operative course: On the seventh day after operation, patient voided and lumbar incisions were dry.

Remarks: "In this case, the ureters had both been ligated with catgut and the lumina were restored as soon as the catgut was absorbed."

Result: Recovery.

9. Barney, J. D. *Primary operation:* "Pelvic operation."

Secondary operation: Bilateral nephrostomy ninety-six hours after primary operation.

Result: Death forty-eight hours after nephrostomy.

10. Barney, J. D. *Primary operation:* "Pelvic operation."

Secondary operation: Bilateral nephrostomy forty-eight hours after primary operation.

Result: Death twenty-four hours after nephrostomy.

Deligations

11. Zweifel. *Primary operation:* Hysterectomy. Double ureteral ligation.

Post-operative course: Anuria for forty-eight hours.

Secondary operation: Ligatures removed from left ureter.

Post-operative course: No bleeding; urine appeared in bladder.

Third operation: Ligatures removed from right ureter on sixth day.

Result: Uncomplicated recovery.

12. Herman, L. *Primary operation:* Subtotal hysterectomy. Woman, twenty-one. April 25, 1921.

Post-operative course: Anuria for forty-eight hours. No uremia.

Cystoscopic examination showed both ureters obstructed at 2 inches from bladder.

Secondary operation: Bilateral deligation.

Result: Uncomplicated recovery. (For details, see text.)

13. Davis, E. P. (This case history was submitted by Professor Edward P. Davis of the Jefferson Medical College of Philadelphia.)

Negro woman, aged twenty-five; pregnant at term; contracted pelvis. Had had a Caesarean section previously, operator unknown. Admitted to the Maternity Department of the Jefferson Hospital.

Examination showed patient practically at term. Abdominal scar. Contracted pelvis; head above the pelvic brim. In labor; no engagement; no descent. At request of patient, delivery and sterilization.

Primary operation: Caesarean section and supravaginal hysterectomy. Some difficulty experienced in forming the stump on account of adhesions. Layers of broad ligament closed by continuous catgut. Abdomen closed without drainage. No hemorrhage or shock.

Post-operative course. Anuria. Condition otherwise good. After thirty-six hours slight pain over both kidneys.

Cystoscopy: Dr. Thomas Stellwagon in consultation. Dr. Stellwagon found both ureters obstructed at the level of the pelvic brim. Patient etherized. Ureteral catheters left in situ.

Secondary operation: Dr. Davis reopened abdomen and found that both ureters had been obstructed by "adhesons" in closing the tissues over the stump by continuous catgut suture. At the points of occlusion, as indicated by the catheters, this catgut was severed; the catheters immediately passed up into the kidney pelves.

Result: Complete recovery.

Note: "Ureters had not been occluded by encircling ligatures but by reason of adhesions by the continuous catgut suture which closed the layers of the broad ligament at the sides of the uterine stump."

14. Dorff. *Primary operation:* Myomectomy. Both ureters obstructed by ligatures which kinked them by drawing together the surrounding tissues.

Post-operative course: Anuria for forty-eight hours.

Secondary operation: Bilateral deligation.

Result: Death after three days in spite of free excretion of urine. Autopsy negative.

15. *Purcell. Primary operation.* Hysteromyomectomy. Both ureters obstructed by ligatures which kinked them by drawing together the surrounding tissues. The ligatures which were of silk, did not encircle the ureters.

Post-operative course: Anuria for fifty-eight hours with symptoms of uremia.

Secondary operation: Bilateral deligation. The ligatures controlled the uterine arteries; no bleeding on their removal.

Result: Uncomplicated recovery.

16. Martin. *Primary operation:* Removal of a multinodular fibroid by Thumin clamps and ligature. Both ureters tied.

Post-operative course: Anuria for forty-eight hours.

Secondary operation: Death in twenty-four hours from peritonitis.

17. Barney, J. D. Bilateral ureteral occlusion due to ligatures.

Secondary operation: Bilateral deligation forty-eight hours after primary operation.

Result: Recovery.

18. Deaver, J. B. *Primary operation:* Hysterectomy.

Post-operative course: Anuria for forty-eight hours.

Secondary operation: Bilateral deligation.

Result: Complete recovery.

Miscellaneous operations

19. Neuman. *Primary operation:* Vaginal hysterectomy by clamp method. Both ureters clamped.

Post-operative course: Anuria for three days. No uremic symptoms. Urine appeared in bladder after removal of clamps. Uretero-vaginal fistula on ninth day.

Secondary operation: Colpocleisis.

Result: Patient cured.

20. Hirst, Barton, Cooke. *Primary operation:* Vaginal hysterectomy by the clamp method. Dr. Hirst kindly sends us the following data: "I have not had occasion to remove a ligature from a ureter, but I had one case, when we were using clamps for vaginal hysterectomy, in which the ureters were shut off completely for thirty-six hours. On the removal of the clamps, there was a free flow of urine and the patient recovered from the operation, but died a couple of years later, I believe from kidney diease."

In answer to our inquiry as to the probable nature of the obstruction Dr. Hirst answers as follows: "I think you are quite right in assuming that the ureters were kinked and not actually compressed by the clamps. That was the opinion I had of the case, because the urine evacuation was immediately resumed, also there were no fistulae."

21. Markoe and Wood. *Primary operation:* Panhysteromyomectomy. Left ureter tied and a segment removed; the right ureter was occluded by being kinked in closure of the peritoneal flap.

Post-operative course: Anuria for forty-eight hours. No uremia.

Secondary operation: Right ureter deligated; left uretero-ureteral anastomosis.

Result: Recovery.

22. Werder, X. O. *Primary operation:* Supravaginal hysterectomy for large submucous fibroid. (March 11, 1901.) Difficult operation. Profuse bleeding.

Post-operative course: Catheterized six hours after operation, 3 ounces of urine obtained. No more urine secreted.

Secondary operation: Abdomen reopened fifteen hours after primary operation. Right ureter found completely severed; left ureter occluded by ligature which included also the ovarian artery. The ureter was uninjured. Right ureter implanted into bladder; left ureter deligated. Iodoform gauze drainage through the vaginal vault.

Post-operative course: Five days after operation, vaginal fistula appeared and after seven days, all of the urine was passed per vaginum. The patient had three attacks of chills with pain and tenderness over the kidneys. Discharged May 12, 1901, the fistula having persisted. Readmitted November 1, 1901, when the examination revealed two minute fistulous openings at the summit of the funnel-shaped vagina.

Third operation: Colpocleisis. Artificial diverticulum of bladder made by joining the posterior wall of the bladder with the posterior wall of the vagina including the fistulae. Cystoscopy two months later showed two compartments to bladder; the bladder mucosa was normal, the vaginal mucosa reddened. Patient discharged January 23, 1902.

Result: Recovery.

23. Pinkham, E. W. Woman, twenty-six, carcinoma of cervix. *Primary operation:* Percy cautery, October 1, 1914. Discharged October 21, 1914.

Post-operative course: Patient returned December 10, 1914, with the statement that for the preceding three days she had passed only a tablespoonful of urine. Catheterized; bladder empty.

Cystoscopy: Ureters obstructed at 2 cm. Refused operation. Readmitted December 16, 1914, stating that no urine had been passed for one week. Intense backache, headache, drowsiness, vomiting, anasarca and general weakness.

Second operation: December 16, 1914, small uterus found imbedded in mass of exudate and cicatrix. Each ureter traced downward where they were lost in mass of exudate. Ureters mobilized from pelvic brim to point as near bladder where they were tied off with linen. A temporary tape ligature tied around each ureter near the linen ligature and the ureters cut between the two. Bladder freed anteriorly and laterally. Bladder opened anteriorly and ureters transplanted through counter incisions in bladder base. Self-retaining catheter in bladder.

Post-operative course: Three ounces of urine passed during first five hours, 10 ounces in first twelve hours. Amount of urine increased rapidly. Catheter removed on eleventh day. Patient out of bed on twentieth day. Convalescence uneventful.

Result: Recovery.

24. Caulk, J. R. Merely refers to a second case of bilateral occlusion of the ureters. No details given except that the patient died without operation.

REFERENCES

(1) Barney, J. D.: Annals of Surgery, May, 1917.
(2) Barney, J. D.: Surgery, Gyn. and Obstr., September, 1912.
(3) Barney, J. D.: Annals of Surgery, March, 1910.
(4) Barney, J. D.: Trans. Amer. Urol. Assoc., 1912, vi, 251.
(5) Barney, J. D.: Trans. Amer. Assoc. Genito-Urin. Surg., 1913, vii, 201.
(6) Blumenfield: Munch, med. Wochenschrift, 1898, xlv, 992.

(7) Caulk, J. R., and Fischer, R. F.: Trans. Amer. Assoc. Genito-Urinary Surgeons, 1915, x, 72–81.
(8) Caulk, J.R.: Surg., Gyn. and Obstr., April, 1920.
(9) Davis, E. P.: Personal communication.
(10) Deaver, J. B.: Personal communication.
(11) Dorff: Centr. f. Gyn., 1896, xx, 764.
(12) Fishel, E.: Urol. and Cut. Rev., 1918, xxii, 446.
(13) Frankel: Arch. f. Gyn., 1901, 64, H. 2, 438.
(14) Furniss, H. D.: Surg. Gyn. and Obstr., 1918, xxvii, 339.
(15) Graves, W. P.: Boston Med. and Surge. Jour., 1917, clxxvi, 149.
(16) Harrington, S. W.: Arch.of Surgery, 1921, ii, no. 3.
(17) Hirst, B. C.: Personal communication.
(18) Judd, E. S.: Journal-Lancet, 1912, xxxii, 543–7.
(19) Kayser, H.: Med. Press and Circ., 1915, n. s., 99, 106.
(20) Kronig: Monatschr. f. Geburtsh. u. Gyn., 1907, xxv, 120.
(21) Markoe and Wood: Annals of Surgery, 1899, xxix, 694.
(22) Markoe, J. W.: International Clinics, 1918 (28th series), ii.
(23) Martin: Centr. f. Gyn., 1899, xxiii, 1255.
(24) Neumann: Centr. f. Gyn., 1899, xxiii, 1184.
(25) O'Neill: Trans. New England Branch Amer. Urol. Assoc., 1919–1920.
(26) Peterson, A.: Jour. Amer. Med. Assoc., 1885–1891, lxxi, no. 23.
(27) Peterson, R.: Surg. Gyn. and Obstr., August, 1929, xxxi, 2, 132.
(28) Pinkham, E. W.: Amer. Jour. Obstr., 1915, lxxi, 916.
(29) Purcell: British Gyn. Jour., 1898, liv, 174.
(30) Robinson, A. L.: Brit. Med. Jour., 1921, i, 665.
(31) Sampson: American Medicine, 1902, iv, 693–700.
(32) Chute, A. L.: Boston Med. and Surg. Jour., 1917, clxxvi, 149.
(33) Smith, G. G.: Trans. New England Branch Amer. Urol. Assoc., 1919–1920.
(34) Stewart and Barber: Annals of Surgery, 1914, lx, 723–728.
(35) Tenney: Trans. New England Branch Amer. Urol. Assoc., 1919–1920.
(36) Werder, X. O.: Jour. Amer. Med. Assn., 1902, xxxix, 360.
(37) Zweifel: Arch. f. Gyn., 1894. xiv, 109.

OBSERVATIONS ON THE KINKS OF THE URETER[1]

J. DELLINGER BARNEY

Boston, Massachusetts

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The literature contains many articles on the subject of hydronephrosis and its known or probable cause. On the other hand there appear to be but three or four titles concerning ureteral kinks and none of these papers has any important bearing on the subject under discussion. The reason for this seems to be that the writers for the most part are dealing with the late lesions of which it is believed two of the cases here presented demonstrate the very earliest stages. While no claim is made that these cases are rare it is certainly unusual to be fortunate enough to encounter them at their onset. I believe, however, that the more universal employment of the ureterogram, as well as the pyelogram will demonstrate that the conditions to be described are not uncommon. My interest was first aroused by the following case occurring on the East Surgical Service of the Massachusetts General.

Case 1. E. W., male aged forty-three, laborer. Admitted, January 8, 1922.

Family history. Negative.

Past history. Unimportant except that he was operated upon for "hemorrhoids" nineteen years ago and had "malaria" eight years ago. Denies venereal disease.

Present illness. About three months ago patient began to have pain in the left upper quadrant. Pain was intermittent at first but has been constant for the past two weeks. About two months ago began to have frequent urination and present situation is now six times by day, twice at night. No dysuria. Pain does not radiate to shoulder or groin but does extend through to the back. Yesterday the pain suddenly became severe enough to "double him up." He was brought to the hospital and given a hypodermic of morphine.

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[1] Read at the meeting of the American Urological Association, Atlantic City, April, 1922.

Physical examination. Well developed, robust man. Head, neck and chest not remarkable. Abdomen is flat, with general muscular rigidity more marked on the left side. Marked tenderness in left upper quadrant and especially in the left costo-vertebral angle. Neither kidney was palpable on several occasions.

Urine (on several occasions) showed nothing but an occasional leucocyte.

Blood Wassermann strongly positive on two occasions.

X-ray of the urinary tract showed no stone nor abnormality.

January 12, 1922. Patient has been in bed since entrance but pain has been almost constant, requiring morphine for its relief. Cystoscopy showed a normal bladder, prostate and ureteral orifices. Number 6 catheters were easily passed into each kidney with no evidence of renal retention on either side. Neither kidney urine contained pathological elements. X-ray with catheters in place showed nothing abnormal but patient pulled out the catheters before a pyelogram could be made.

Two days later another cystoscopy was performed by me with the same findings, but this time a pyelogram and a ureterogram were done on the left side. This showed a pelvis which was slightly if at all dilated and a ureter of apparently normal size and direction. A ureterogram with the catheter pulled down below the brim of the bony pelvis showed a very sharp and definite kink in the ureter opposite the lower pole of the left kidney with no evidence of dilatation above or below it.

January 17, 1922. Operation was advised and was performed by Dr. D. F. Jones, using straight ether anesthesia. I quote the notes from the record:

"Kidney high and moved only about an inch. The ureter was small, flexible and not held in any way by visible or demonstrable bands. The pelvis was very small and there were no adhesions. There appears to be no pathology sufficient to account for pain which the patient had up to the minute he took ether. The kidney was delivered, the capsule split longitudinally and the kidney suspended, using this capsule as a hammock."

January 29, 1922. Patient had a normal convalescence with no pian whatever.

Cystoscopy done by me, together with another pyelogram and ureterogram showed that the kink so well shown previously had entirely disap-

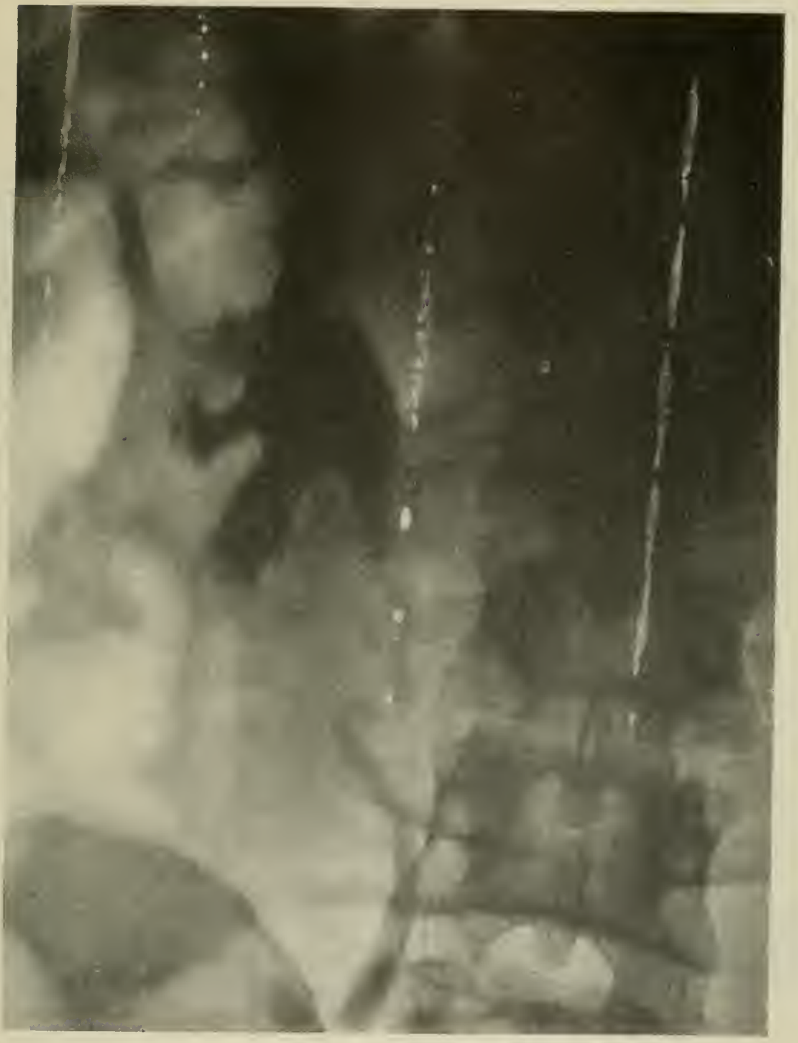

Fig. 1. Case 1

Before operation showing small amount of dilatation of renal pelvis on the left with a definite double kink of the ureter, the lumen of which is narrower at this point and above.

peared and the course of the ureter and the appearance of the renal pelvis were normal (fig. 2).

The man has since been seen in the Out Patient Department and has been perfectly comfortable. He has also been examined for a possible syphilitic affection of the cord and none has been found.

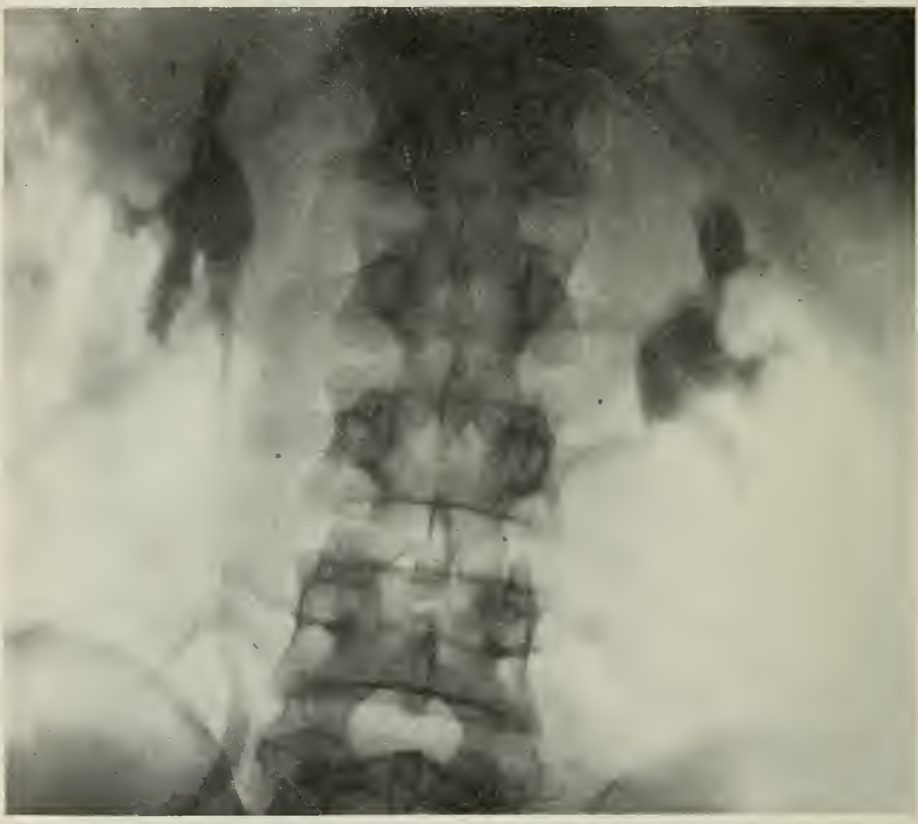

Fig. 2. Case 1

After operation showing the same kidney and ureter. Kink obliterated

The preoperative findings in this case were so definite and operative findings so conspicuous by their absence that were it not that another similar case was admitted about a week later in which very positive discoveries were made I should be inclined to doubt the value of the ureterogram as a means of diagnosis.

Case 2. G. C., male, aged thirty-three, ice cream maker. Admitted to the Genito-Urinary Service, January 16, 1922.

Family history. Unimportant.

Past history. Operation for left inguinal hernia in 1908. Urine negative at this time. Pleurisy with effusion in 1910. Fistula in ano operated upon three times with final cure. "Acute articular rheumatism" in 1911 lasting ten weeks. "Gonorrhea" in 1912 soon "cured." Otherwise perfectly well till one week ago.

Present illness. For the past week has had a dull intermittent pain in the region of his (left) hernia scar.

Yesterday this pain became more severe so that patient had to go to bed but got a good night's sleep. Felt perfectly well this morning and went about his work as usual.

At 3:00 p.m. today the same dull pain began again and kept increasing. An hour later the pain became so severe that patient consulted a doctor who referred him at once to the hospital.

Physical examination. Well developed, healthy young man apparently in no pain.

Head, neck and chest negative. Lungs show no evidence of old pleurisy.

Abdomen level, soft, and tympanitic. No masses or tenderness. No costo-vertebral tenderness. Reflexes normal.

January 19, 1922. Patient had been in bed and perfectly comfortable. Last night was awakened from sleep by severe pain in the left side radiating to the left scrotum and relieved only after the injection of morphine grains $\frac{1}{6}$ on two occasions.

Cystoscopy (C.M.S.,) showed a rather large prostate for a young man. Both ureteric orifices a little stiffened. Number 6 catheters pass readily to each kidney with normal flow from each.

Both urines rather bloody.

Left urine sediment showed nothing but blood. Smear and culture negative.

Right urine sediment also negative but showed B. coli in culture.

Bladder urine was clear, yellow, acid, albumen s.p.t., no sugar.

Sediment contained 15–20 red cells, 2 or 3 white cells.

Non-proteid nitrogen 44.7 mgm. per 100 cc. of blood; later showed 33 mgm. per 100 cc. of blood.

Phenolsulphonphthalein showed an appearance time of eight minutes with a total two-hour function of 30 per cent.

X-ray, including pyelogram and ureterogram showed a low right kidney, the pelvis being at the level of the space between the third and fourth lumbar vertebrae. The injected pelvis of the left kidney shows it to be somewhat bifurcated with two very definite divisions neither of which is dilated.

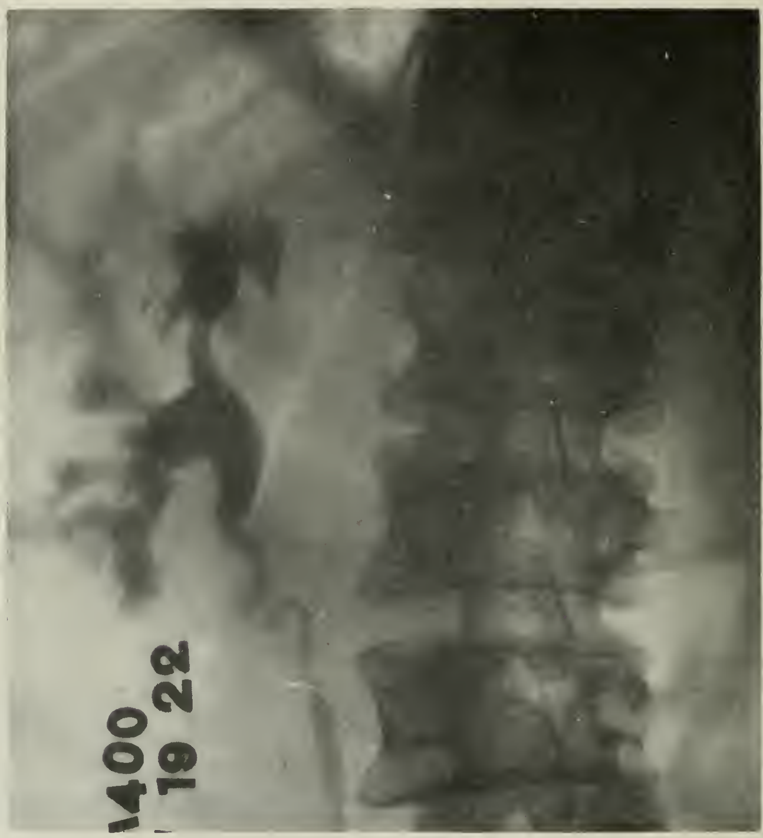

Fig. 3. Case 2

Before operation showing pyelogram on the left with a bifid pelvis and a double kink of the ureter.

With the catheter in the kidney the course of the ureter is not abnormal. A left ureterogram, with the catheter pulled well down, shows a very tortuous ureter with a marked S-shaped curve at a point about opposite the lower pole of the kidney (fig. 3). No evidence of calculus.

January 23, 1922. Patient had a good deal of pain in the kidney following cystoscopy and was given morphine for its relief.

Having in mind the unsatisfactory findings at the operation in the first case it was decided to try some means of demonstrating the preoperative findings in other ways.

Operation (J. D. B.). Ether. Patient cystoscoped and catheter passed up left ureter into kidney. Left oblique incision. Kidney not adherent or abnormal in size, shape, consistency or mobility. The ureter, with the catheter in place, was then gently exposed with as little disturbance as possible of the surrounding tissues or of its sheath, and was found to be absolutely normal in size and direction with no suggestion whatever of the kink found previously. A large vein running internal and parallel to the ureter (probably the spermatic vein) was divided between ligatures. The catheter was then withdrawn well down the ureter and injected with 10 cc. of normal saline solution, whereupon the kink found by X-ray was reproduced exactly. It was further observed that the sharp curves made by the ureter were very much intensified with the descent of the kidney during inspiration, creating the impression that there was a redundancy of the ureter in respect to its length. Close examination showed that there were numerous fine bands of connective tissue attached to the ureter here and there and so arranged that the ureter curved out between them, giving a very definite reproduction of herniation of the sheath of connective tissue with which the ureter is normally surrounded. It appeared that owing to these weakened areas in this sheath the ureter had more lateral play in one place than another. In developing the lower pole of the kidney and its pelvis it was noted that the fat was remarkably profuse in amount and also rather more adherent than usual. By lifting the lower pole of the kidney outward and pressing it against the chest wall it was found that the ureter was straightened completely and did not form any curves even during inspiration. A modified suspension operation, using the capsule as a hammock, was accordingly performed.

Convalescence was uneventful, there being no pain whatsoever. Before leaving the hospital another pyelogram and ureterogram was made (fig. 4) showing that the curves previously seen in the ureter had entirely disappeared. It was also seen that the ureter had a somewhat segmented appearance due possibly to peristalsis, possibly to constrictions produced by the defects in the connective tissue sheath already noted.

This patient has been seen several times since operation and has been entirely free from all pain or other symptoms and the urine is normal.

I may say that both these patients will be carefully followed for a much longer period of time as it is believed that ureterograms a year or more later will be quite as interesting and possibly more valuable than those already seen.

Not long ago we had an identical case in a woman of thirty, on the right side but of about a year's duration. Although the urine was still uninfected, the pyelogram showed a considerably dilated pelvis with a ureter almost exactly like those already described. No operation was performed in this case.

Another case is that of a man of fifty with left sided renal colic of about four years' duration, with an infected urine containing a little blood and pus and whose ureterogram showed a definite kink of the left ureter at about the level of the pelvic brim. At operation, which was done by my colleague Dr. E. G. Crabtree, a very adherent kinked ureter was found. Adhesions were freed and nephropexy performed because of the low position and mobility of the left kidney.

Finally there was a man of thirty-one with a history of right renal colic during the five years previous to his entrance to the hospital. Investigation showed a sharp kink in the right ureter just below the kidney while the renal pelvis was very markedly distended. In spite of the duration of symptoms and the condition of the kidney the urine was uninfected and free from pus. At operation a sharp kink was found in the ureter produced by a firm band of adhesions. There was also definite hydronephrosis.

No attempt has been made to go through the records carefully nor is it probable that these are all of the cases of this type which we have had. They are unquestionably much more frequent than is supposed; it is equally certain that they are often missed because the proper means for their detection are not employed. Unfortunately they are also often filed under the diagnosis of "hydronephrosis."

The experience here narrated and the few cases recited demonstrate certain things beyond any reasonable doubt. Kinks of the ureter, or sharp and abnormal curves, may occur in men or women, on either side and in any portion of the ureter although they seem to occur largely in its upper third. Such kinks can be demonstrated only by the injection of some opaque fluid into the kidney and ureter, but the ureteral changes can be shown only by withdrawing the ureter catheter to a point well down in the bony pelvis and injecting the ureter separately afterwards. Otherwise the catheter acts as a splint and obliterates the kink. Careful observation at operation suggests that these abnormalities

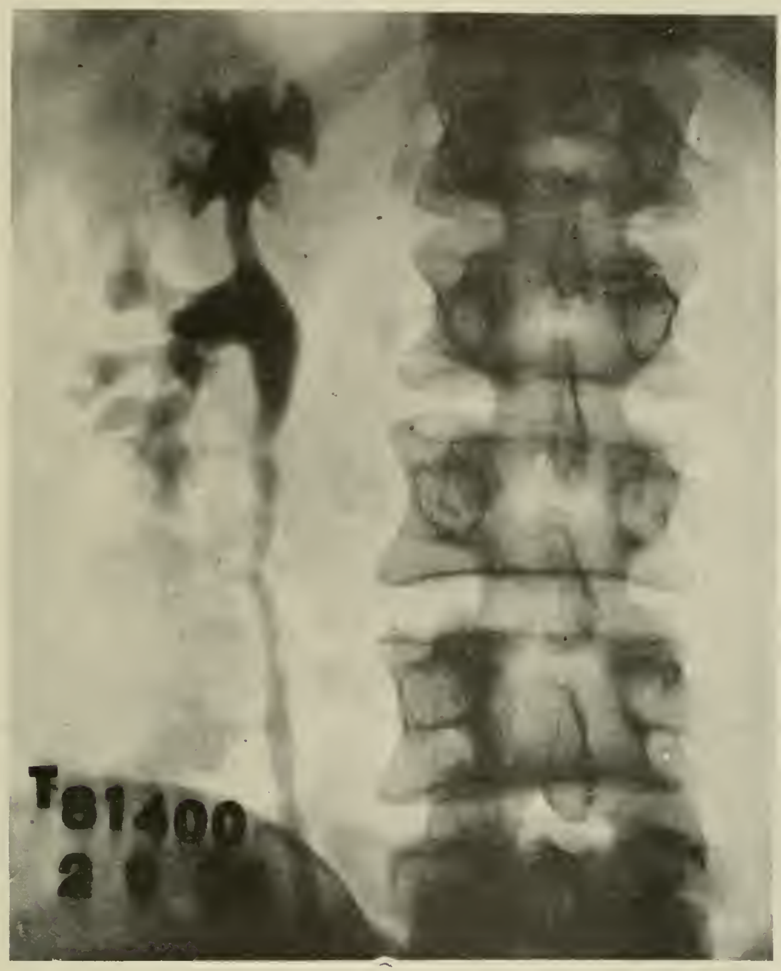

Fig. 4. Case 2
After operation showing obliteration of the kinks of the ureter

in the course of the ureter may be produced by probably two factors, namely undue mobility of the kidney, and especially by a lack of support of the ureter as regards the lateral motions, by a weakness or herniation of its normal sheath. It is also shown by the cases here presented that when the condition has existed for a considerable time (years) hydronephrosis of greater or less degree is to be expected often without an infection of the urine. It seems to be equally true that when found early the ureteral kink is neither fixed in its position nor is there any accompanying dilatation of the renal pelvis. The former statement is justified by the experience in Case 1 where nothing pathological was found by the surgeon. Had the ureter been injected as in case 2 the conditions found in the ureterogram would undoubtedly have been reproduced. A study of the records of these cases, together with personal observation in three of them shows that the symptoms are identical with those produced by renal or ureteral calculus and one may at first be at a loss to say whether he is dealing with a calculus which the X-ray does not reveal or with a ureteral kink.

It is believed that the means adopted in Case 2 for demonstrating the abnormality in the course of the ureter has not hitherto been employed. It would seem as if so simple a procedure might at times be of great value.

The probability seems strong that the onset of infection and the deposit of inflammatory tissue necessarily and eventually induced by such changes in the course of the ureter as has been shown in cases 1 and 2 will sooner or later give rise to permanent alterations in the course of the ureter similar to those seen in cases 4 and 5. Because of this and because the continuance of the condition must inevitably give rise to hydronephrosis early operation should be advised.

DISCUSSION

Dr. Guy L. Hunner (exhibiting lantern slides): This is the type of case in which I think we should not operate. When the ureter becomes obstructed from a low stricture, it dilates. It is apparent if the ureter is not fastened near the kidney that it prolapses and forms these apparent kinks. It is interesting that the ureter is only partially dilated down quite low in the pelvis. The real dilatation begins in the pelvic brim region and I never got a hang in her case except near the bladder. She has had a periureteritis and it has dilated this partially where there has been a periureteritis.

This kidney held 33 cc. and the left, which was also strictured, held only 12 cc. This was the only case out of about 30 cases of pyelitis of pregnancy in which I consented to have an abortion performed. This patient had a history of losing one child after being blind for about a week and of having a hard time with the first child.

This second case was thought to be a cholecystitis and we examined the urine and found kidney trouble. This ureter (indicating) held 30 cc., the other about 15 cc., both with colon bacillus infection. This patient after dilatation, three times on both sides, was clear from infection. I have heard from her several times in the past two years. You see the apparent kink near the kidney, which we can ignore for the upper ureter, is not caught up by any obstructing bands.

This plate represents the first case that I had with a partial pyelonephrotomy. There had been symptoms for several years when the patient came under Dr. Friedenwald's care. He found a mass in the left side and I found the kidney contained 12 ounces, 360 cc., and still the urine was perfectly normal. She was of the type with the pelvis dilatation and very good 'phthalein output, the same on both sides. After dilatation she was perfectly comfortable as long as she remained on her back in bed. After two or three days she felt like getting up and then she had a backache. After dilating her several times I decided that the return of symptoms when on her feet was due to the large saccular pelvis causing lateral pressure on the upper ureter. We resected practically the entire pelvis, the calices were very small and measurements after operation showed that the pelvis held 8 cc. She went home one December and the following December had tonsillitis and began to have a little pain in the left side and in March she had pain in the right of just the same nature. In those days we were not doing both sides on the patient's first visit, in the absence of symptoms, and we found stricture on the other side on this second visit. She had both sides dilated and her tonsils removed four years ago and has been perfectly well since.

Here is another that I had to operate on. The ureter plunges directly into the pelvis. No thorium leaks back here (indicating), or practically none. The ureter shows no dilatation because there was no back flow, but you have to take my word for it that there was dilatation. She got better after dilatation but after this it kept her from work because of pain. Why not take the kidney out? She had stricture on the other side. This supposedly worst side yielded 20 and the other 10 per cent 'phthalein. All we had to do was a suspension. This was almost an intrarenal affair, so we just did an ordinary suspension and straightened the ureter out. I think the aberrent vessels are secondary in their action rather than primary in these cases when they are present.

Here is another ureter emptying directly into the kidney. This picture shows the catheter withdrawn and you can see the fluid trapped in the kidney and nothing showing in the ureter.

The pelvis held 130 cc. I resected in this case although much of the dilatation was intrarenal. I resected and reduced the residual from 130 to 20 cc. This was one of my very successful cases.

I have not the time to go into the details of the clinical picture in these cases. This one held 230 cc. and looks like a central kink. I resected this and got it down to 100 cc., but the big vessels came across and I could not do more.

This patient I had to send home with a tube in her side. The kidney held about 70 cc. This is the only kidney she has, for the other is atrophic.

(Showed a series of pictures with stones at various places having formed because of stricture.)

Some of these cases had dilatation at the expense of the kidney or in the calices, others at the expense of the pelvis, and others will have practically all of the dilatation at the expense of the ureter.

Dr. George G. Smith, Boston: I should like to discuss Dr. Herman's paper. I have been interested in and congratulate him on the results. I think he did not read the report of my two cases right. He said they were unsuccessful; I thought they were pretty good. One had not passed any urine for seventy-two hours. I did a bilateral nephrostomy, later did plastics upon both ureters, and the woman had a perfectly good functional result.

The other case was one of cancer of the uterus in which I reimplanted the ureters into the bladder at a second operation, having done a bilateral nephrostomy first. She did well, except that the left nephrostomy sinus never completely closed. I was going to do a second operation but she had a return of the carcinoma in the vagina, so it did not seem worth while.

Dr. A. E. Goldstein, Baltimore: I was interested in Dr. Herbst's paper regarding ureteral stricture. I was interested in this and reported 23 cases of ureteral strictures in the male. Of those only one had had gonorrhea and that individual's prostate and seminal vesicles were normal. The other 22 had had no venereal disease. In that paper I made mention of the fact that every ureteral obstruction is not a ureteral stricture. That may come from a seminal vesicle affair. We can have a real obstruction and yet not a ureteral stricture. I am sorry Dr. Herbst did not show some pyelograms. In my cases 100 per cent showed dilatation of the ureter and pelvis above. In twenty-two cases of the 23 I got a positive hang and 22 showed a positive dilated ureter and hydronephrosis. A correct picture can only be obtained with the catheter drawn down just above the opening in the bladder. If it is left up in the pelvis you cannot get a correct picture of the ureter. It must be down below the arch. In ureteral stricture one does not make the diagnosis by being able to pass a catheter in but by the hand obtained on coming down, together with ureteropyelograms. You can take an ordinary no. 6 catheter and get into the stricture, but if you do a pyelogram with a bulb you will get a hang and also get dilatation of the ureter.

One other point, and that is in a series of 81 cases which I worked on serially with ureteral pyelograms, taking them from one to twenty-five minutes after injection, I found normal ureters and pelves will empty themselves within four to seven minutes. If there was a ureteral stricture I found some of the opaque solution after seven minutes.

Dr. E. G. Crabtree, Boston: I want to place on record another case of bilateral ureteral obstruction. The patient was a woman of sixty-three who had had both ureters sutured into the stump of the uterus. Four days had elapsed without the passage of any urine whatever into the bladder. Cystoscopy was done, showing that both ureters were obstructed about three cm. above the bladder. Bilateral pyelotomy was done. Both kidney pelves were tightly distended with urine. The kidneys were hard, congested, and somewhat enlarged. A very rapid operation was done, without freeing the kidney, but simply drawing it forward and puncturing the pelvis. A large rubber tube was passed down to the puncture wound in the pelvis and the wound hastily closed. There was a rapid elimination of urine through the tubes, and the patient recovered. Ten days later the patient was cystoscoped, and the ureters dilated through the operating cystoscope; after which the pyelotomy wounds closed and normal urination was established. There was complete recovery of function in both kidneys, and no permanent dilatation resulted.

Dr. A. J. Crowell, Charlotte, N. C.: With regard to Dr. Hunner's paper, I wish to say that such cases of ureteral kink as he showed on the screen are the ones frequently diagnosed as stricture. Ureteral stricture and kink can be differentiated only by the use of the ureteropyelogram. I do not think much of a diagnosis made by the pull. The kink will produce a "pull" and it is unfair to call anything a stricture which causes a "pull."

I wish to mention a plan of treating kinked ureter which I feel worth while. We have used it in only one case but our results, as shown in ureteropyelograms, were such that we feel justified in reporting it in this connection. This was a case in which we had two right angle kinks in one ureter and which was accompanied with all the clinical symptoms found in cases of obstructed ureter. After studying the ureteropyelograms, Dr. Todd suggested that a catheter be inserted above both kinks and left in for four or five days to see if sufficient reaction might be produced to hold the ureter straight. To this I readily consented. The catheter was inserted but came out at the end of three days. A ureteropyelogram was taken one week later and showed the ureter in a perfectly normal position. Just what this means we can't say but shall keep it in mind and try it further as other cases present themselves.

Just such cases are often benefited by operation and we don't know just what we have done. In all probability break up adhesions, sever aberrant blood vessels, and straighten out the ureter and thus obliterate the kink. Dr. Braasch says Dr. Will Mayo calls it "going in, mussing around, doing nothing and curing the patient."

Dr. Irving Simons, Nashville, Tenn.: I think Dr. Barney has rendered a distinct service in calling attention to this condition. I think many conditions show up in the pyeloureterograms for which we are at a loss to say whether it is really worth while to operate. I know many cases in the last few years that were not operated on account of our inability to interpret the pyeloureterograms and to decide on operations and these were not improved.

I recently operated on a case which made me sure that I will in the future try to diagnose this condition. This case had a real kink in the ureter with a real step-like formation. I simply cut down and suspended the kidney and produced complete recovery. The pyeloureterogram gave more evidence of ureteric distortion than was found at operation.

Dr. F. C. Herrick, Cleveland, Ohio: For many years I have been interested in kinks of the ureter and firmly believe we are missing something when we do not recognize them. I have a large number of pyelographs showing them and have been trying to analyze the situation and explain them. In so doing, we must recognize that the kidney and ureter are held in their respective positions by two entirely different groups of supports. These supports are of a different nature and are subject to different kinds of force in displacing the kidney and ureter respectively. For instance, the kidney is supported, first by the renal niche described by Walkow and Dilitizn, by Harris and others, in which the kidney naturally rests; second, the renal fascia reflected over it both anteriorly and posteriorly and forming a bag with its opening pointing downwards. These layers of fascia reunite over the spine and pass to the opposite side, again becoming two planes; third, the fatty capsule encasing the kidney more abundant at the lower pole being more or less trabeculated, the trabeculi being fastened to the true capsule and the renal fascia; fourth, the intra-abdominal pressure and muscular tone of the abdomen.

In contrast to these the ureter is supported by being fixed closely to the posterior surface of the peritoneum. This point has not in the past been sufficiently recognized in surgery until recent years and is of very great importance, as I brought out, in searching for ureteral calculi and in surgical approach of the ureter. There is a reflection of fibers over the ureter holding it closely to the peritoneum so that when the peritoneum is drawn up the ureter goes with it. This attachment to the peritoneum has an upper limit, for the ureter must leave the peritoneum in taking its oblique course posteriorly to the kidney pelvis. The point at which it leaves the peritoneum is about 4 to 6 cm. below the renal sinus and is in most cases an easily demonstrated point. At operation, it is easy in many cases, to slip a hemostat or other instrument alongside of the ureter into its canal, demonstrating this upper fold of its attachment to the peritoneum.

In something over forty cadavers I worked out the relations of the ureter to the peritoneum and the kidney, and planned a triangle formed by the ureter, the renal vein and the inferior cava, the apex of which is about at the crossing of the spermatic vessels. From these two different forms of support for the kidney and ureter it is perfectly apparent that different types of force will be necessary to displace these two organs. Furthermore, that trauma, lifting, heavy strain, etc., which displace the kidney, will have no affect upon the ureter, so that the kidney becoming displaced downward, the upper fixed point of the ureter where it leaves the peritoneum, becomes the point of kinking.

Clinically, these cases are subject to very violent colic, to retention of fluid within the renal pelvis, to the favoring of the developing of infection in the renal pelvis and form a large group in which other abdominal operations had been performed to relieve these symptoms on a mistaken diagnosis. A proper nephropexy gives great or entire relief but the subject of nephropexy must be thoroughly worked over along the lines above outlined.

Renal colic is caused so much more often by other conditions than stone that I have been in the habit of making the statement to the general practitioner and surgeon that, given an attack of renal colic as the primary symptom, it is presumptive evidence that the trouble is not due to stone.

I have had only two cases of nephropexy in which the pain recurred after operation. One of these I have not been able to follow recently and the other has been relieved by an abdominal binder with the proper pad. Such support should, of course, not be necessary after operation but at present she has perfect comfort which she did not get before operation with the support.

I recently had a doctor's wife under care for renal colic due to renal ptosis. Instead of a nephropexy, the husband got her to use the knee and chest position, holding it for fifteen minutes three times a day. This has thus far given her great relief.

Dr. W. F. Braasch, Rochester, Minn.: Judging from the remarks made with reference to ureteral dilatation, one might infer that it is easy to diagnose. I have very often had considerable difficulty in doing so. Owing to elasticity of the ureteral wall the normal ureter when distended by the injected medium may appear to be dilated. It is not unusual to observe a portion of the ureter incompletely filled with urographic medium, so that it gives the appearance of a localized narrowing which may be falsely interpreted as actual stricture. There may be an evident dilatation in a portion of the ureter, but unless dilatation of the pelvis and calices above it can be demonstrated, it is very difficult to make a diagnosis. In the diagnosis of kink in the ureter, the existence of ureteral tortuosity alone is worthless, unless definite dilatation of the pelvis or calices above is demonstrated. Even a definite diagnosis of slight pelvic dilatation may not be easy. It is not unusual to observe a pelvis in which it is impossible to determine definitely whether it is a large normal pelvis or an early dilatation. Therefore, unless a dilatation above the ureter can be definitely determined, the localized areas of ureteral dilatation are of no value from the clinical standpoint.

Dr. Hugh H. Young, Baltimore: I wish to refer briefly to stricture in the male ureter. As reported by Herbst, this is very seldom recognized and rarely operated. I have had two such cases, both due to vesiculitis binding the ureter and producing a stricture of the lower end. One of these cases is reported in Guyon's Annals in 1903 and has been referred to in a recent article by Mark.

In this case (B. U. I. no. 352) a nephro-ureterotomy was carried out. The specimen is shown in the photograph (fig. 1) in which the strictured terminal portion of the ureter was bound to the right seminal vesicle by dense adhesions. In a more recent case the stricture was relieved by an extraperitoneal operation in which the seminal vesicle was separated from the ureter and the fibrous band which surrounded the ureter was removed by dissection, thus completely freeing the strictured area.

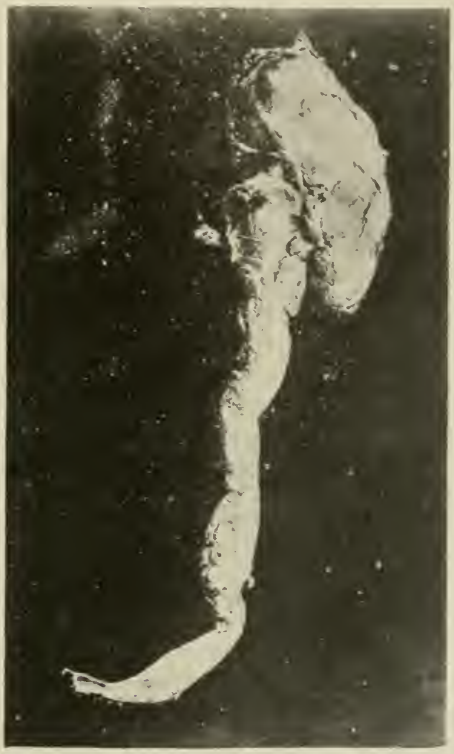

FIG. 1. KIDNEY AND URETER SHOWING THE STRICTURE AT ITS LOWER EXTREMITY

Dr. **CHARLES E. BARNETT**, Fort Wayne, Ind.: Dr. Young speaks of distortion of the ureter on account of pathology in the seminal vesicle. I brought out this question before this Society several years ago (Surg., Gynec. and Obstet., February, 1920, pp. 122–125) in an anatomico-surgical study of the seminal vesicles showing that the vesicle could be enucleated everywhere except at its superior external border (vascular pole) where there is a concentration of vessels and connective tissue which is inserted into the ureter as it passes that point. This immobilizes the seminal vesicle and ureter with each other, consequently any distorting pathology of either the vesicle or ureter at this point would influence them conjointly. For instance, in extensive eccentric dilatation of the bladder whereby the pushing away of the vesicle will pull the ureter into a kink. In this study whenever pathology was found present in the superior external border or vascular pole of the seminal vesicle, pathology was also found present in the ureter. A block was frequently found at this portion of the ureter with a dilatation of the proximal end of the ureter toward the kidney, in contradistinction to the stenosed, or normal, distal end toward the bladder.

I was much impressed with Dr. Barney's paper showing the simplicity in its etiology and pathology, of the dilating ureter.

Dr. C. E. Burford, St. Louis, Mo.: One discussion this evening about ureteral kinks called my attention to something which I had thought was original with me. Dr. Crowell mentioned a method of straightening out kinks which is similar to that I had used. I removed a stone from the right kidney of a man weighing about 225 pounds and he had colics on this side some five years later. This led us to do a cystoscopic examination and make pyelograms and we found a ureteral kink but he still had sufficient function. The attacks increased in severity and frequency, so that he was having them every night or every second day. I cystoscoped him in the office during a colic and withdrew 2 ounces of urine from the right kidney pelvis that was infected, which relieved the colic. Within thirty minutes after the catheter was withdrawn he had another attack, although he was lying on the table all the time. I took him to the hospital and put in a no. 6 ureteral catheter and left it in for a week. Since then he has been on his feet and made a trip to California, but has had no colic at all. Whether this makes a round cell infiltration and stiffens up the ureter or not I do not know, but it certainly has caused the kidney to drain perfectly in this case.

Dr. **Richard F. O'Neil**, Boston: In some of the slides shown by Dr. Hunner it seemed to me the degree of hydronephrosis present without dilatation of the ureter could not be due to any obstruction at the lower end of the ureter, but was more typical of the picture seen when the obstruction is near the renal pelvis, due to an aberent vessel, or adhesions about the ureter causing a kink.

Dr. **Guy L. Hunner**, Baltimore (closing): I understood Dr. Herman to say that there has been no bilateral implantation of the ureters because of obstruction. I had the questionable distinction of having such a case in a patient with carcinoma of the cervix in which I reanchored the ureters. She had passed no urine for twenty-four hours. After attempting to pass a catheter, I operated and found not only deligation of the ureters but that they had been cut off. I implanted both ureters. That was twelve years ago and she is in blooming health.

Dr. Barney brought out the point of using sodium bromid solution in these cases and that it is of great value in studying the nature of the kinks. For all the high respect I have for Dr. Barney, and always have had, if he will pass a bulb on those cases he showed, he will get definite evidence of stricture being present. It is a case of misinterpretation of the x-ray picture. Every one showed a dilatation below the kinks as well as above and the good results did not come from the fixation, but from his preliminary catheterizations.

These cases come in with renal colic or some symptoms of the urinary tract. The plain X-ray is negative, we get the pyelogram and then we do not see the strictured area when it is there and we do not see the dilatation when it is there. It is just a case of misinterpretation. He probably has not passed more than a no. 6 or 7 catheter and probably will get only temporary relief.

In the cases Dr. Crowell and Dr. Burford mentioned they left the indwelling catheter and in some cases you can get relief in that way, but it is due to the dilatation the catheter gives. Dr. Barney's cases will be back and he can pass something larger and find out whether they really have stricture.

Dr. Leon Herman, Philadelphia (closing): I regret having left the impression that Dr. Smith's cases were not successful. They were very successful, but were successful because of his great skill in overcoming the effects of the nephrostomy and not because of the nephrostomy.

I wish to show you three slides. I think no one will question that in the average case the method of choice is deligation. If accompanied by complications, then I agree with Dr. Smith that it would be a dangerous thing to open the abdomen. If you will analyze the paper carefully I think you will agree that the safest thing to do is deligation, barring complications such as peritonitis or pyelonephritis.

Dr. J. D. Barney, Boston (closing): I think the interpretation of X-ray plates works in two directions. The cases of Dr. Hunner did not convince me that there were strictures in the ureter in a lot of instances. Why was the ureter dilated before the pelvis? In the second place, in reference to my own cases, how does it happen if those are strictures—and of course I have not gone to the length he has gone and passed a large bulb—if they are strictures I think we will agree that they have been of some duration and one would suspect a previous infection, or infection at the time they were seen. Such strictures do not occur over night, but only after weeks or months, and naturally we would expect some dilatation of the kidney. I find in many cases one can push up with a catheter in a loose ureter and when you draw out the catheter the kink will disappear. In two or three of his cases this was shown and it is possible that the catheter was pushed up and produced the kink that he has found.

Again, why is it if one has a kink the passage of a catheter or bougie on only one occasion will produce a cure. That is not the case in any other part of the body, but according to your statements the passage of the sound or bougie will cure these if this is done on only one or two occasions. This is not true in other parts of the body and I think we need a good deal more proof than we have at present that they are so numerous as they appear to be.

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DIATHERMY IN THE TREATMENT OF TUMORS OF THE LOWER URINARY TRACT[1]

B. C. CORBUS

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To the urologist, cancer offers the same baffling problem that it does to the general surgeon.

The methods available for the destruction of cancerous tissue are: Excision, X-ray, radium, fulguration or desiccation and thermic electro-coagulation. During the last few years, radium has moved into the position that was formerly occupied by the X-ray and methods adopted for the treatment of cutaneous cancer have been wonderfully successful.

However, it is not my intention to discuss before this association the relative merits of excision, X-ray or radium in the treatment of cancer. Those of you who have had the most experience fully realize your disappointment.

FULGURATION OR DESICCATION

Some confusion has arisen concerning the nomenclature that is used in describing the different methods of electrical coagulation.

Fulguration or desiccation is produced by the unipolar action of sparks of high frequency and high tension (Oudin's current), and produces only a carbonization of the tissues, thereby lessening heat penetration.

Thermic electro-coagulation (diathermy) is the application of thermic properties of bipolar currents of very high frequency and low tension (d'Arsonval current).

Few urologists realized that the superiority of the bipolar current over the unipolar current in the treatment of papilloma was due to the more penetrating action of the heat caused by the "sparking" of the d'Arsonval current.

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[1] Read before American Urological Association, Atlantic City, New Jersey, April 27, 1922.

The effect of the bipolar current on cancerous tissue is so rapid that it becomes possible to obtain, in thirty seconds, destruction of tissue a hundredfold more extensive than that produced by fulguration in many minutes.

The thermo-penetrating action of the d'Arsonval current is unique, as it alone possesses the property of producing a great depth of heat in the tissue. However, this is present only under one condition and that is when there is no carbonization of the superficial tissue. The thermo-penetrating action will not take place if the site of the active electrode is covered with carbonized tissue, and this invariably takes place whether you "spark" with the unipolar or the bipolar current.

HEAT IN CANCER

In the attack on the cancer cell with heat, we must bear in mind that pathological cells offer less resistance to all destructive agents than do normal cells.

This lowered vitality of cancer cells dominates the whole question of the local treatment of cancer by heat.

"Sparking" and carbonization with the d'Arsonval current is not new to most urologists. However, few of us realized that the carbonization of the tissues by "sparking" was the one thing that prevented heat penetration. The fundamental thing in the use of heat, which has not been entirely understood by those of us who wish to make use of it in a successful way, is that the results depend on the dissemination of heat until the tissues known to be involved in the malignancy and those only suspected to be involved are fully infused. Percy says: "The essential, the necessary, the important element, is a degree of heat that laboratory and clinical experience has shown will kill the cancer cell in the tissues, regardless of whether it takes a long or short time to get it there."

Great credit should be given to Dr. J. F. Percy for the persistent way in which he has advocated the use of heat in the treatment of cancer. While I am not in favor of his method, I am heartily in sympathy with the idea.

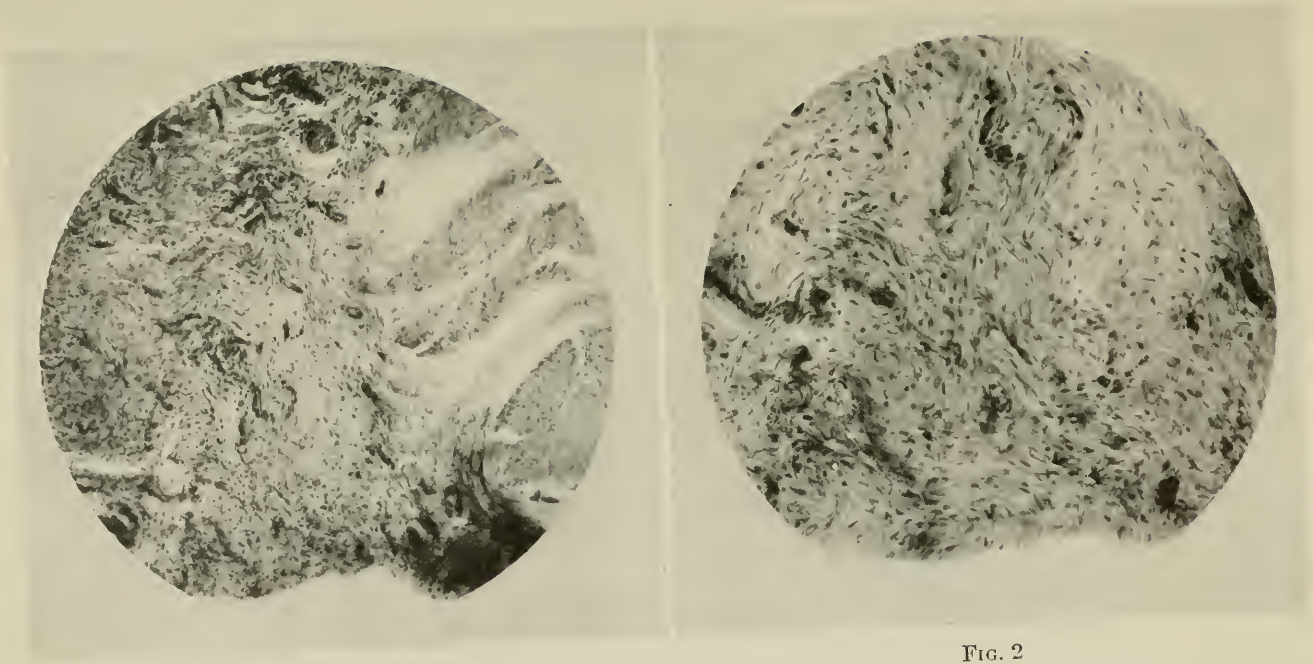

Fig. 1

Fig. 2

Figs. 1 and 2. Microscopic Sections of Scar Tissue Taken from Dog's Bladder Twelve Weeks after Diathermy Burn

The areas show a sharp line of demarcation between the surrounding tissue and the diatherminized area. The latter is entirely replaced by bands of fibrous tissue arranged both longitudinally and transversely.

He has reviewed in numerous articles the different methods of combating cancer, and has mentioned many different kinds of injections, most of which are characterized by febrile reactions.

In one of Percy's articles, written in 1914 (1), he gives a brief résumé of the work done by different men in their experiments on malignant tumors. He says that Jensen has placed the vulnerability of cancer cells at 47°C. (116.6°F.) for five minutes; Loeb for sarcoma at 45°C. (113°F.) for thirty minutes.

Lambert (cf. Percy) has recently pointed out that temperatures above 42°C. (107.6°F.) were distinctly harmful, and that the degree of injury to both normal and cancer-tissue depends on the degree of temperature and length of exposure. He further states that sarcoma-cells are destroyed by exposure to 42.5°C. (108.5°F.) for from twenty-four to forty-eight hours; 43°C. (109.4°F.) for six hours; 44°C. (111.2°F.) for fifty minutes; and 46°C. (114.8°F.) for twenty minutes; while normal connective-tissue cells survive these various exposures.

E. Vidal (cf. Percy) noted the arrested evolution of tumors in four patients with a temperature above 40°C. (104°F.). In order to be sure that this was not a quadruple coincidence, he daily exposed tumor-bearing mice to temperatures above normal, and found that they lived longer and that the tumors were the seat of degenerative changes. In a bitch having a spontaneous lymphosarcoma, the zone of Richet was punctured, the temperature rose to 48.8°C. (105.3°F.) and the tumor diminished in size rapidly and finally entirely disappeared. In this connection, Vidal makes the startling and original observation that the methods of treating carcinoma by vaccines and toxins, etc., are all attended by a reaction, the principal symptom of which is an increase in temperature, and when such reaction is absent, the several authors state that there is no salutary influence on the carcinoma. He concludes that these various methods owe their success largely to their fever-producing qualities.

It has been shown conclusively by numerous laboratory workers that the malignant call cannot be successfully transplanted after an exposure of ten minutes to a temperature of 113°F. (45°C.). It likewise has been shown that normal tissue cells will bear a temperature of 132°F. to 140°F. (35°C. to 60°C.) without being destroyed.

Two methods of destroying the malignant cells by heat are available.

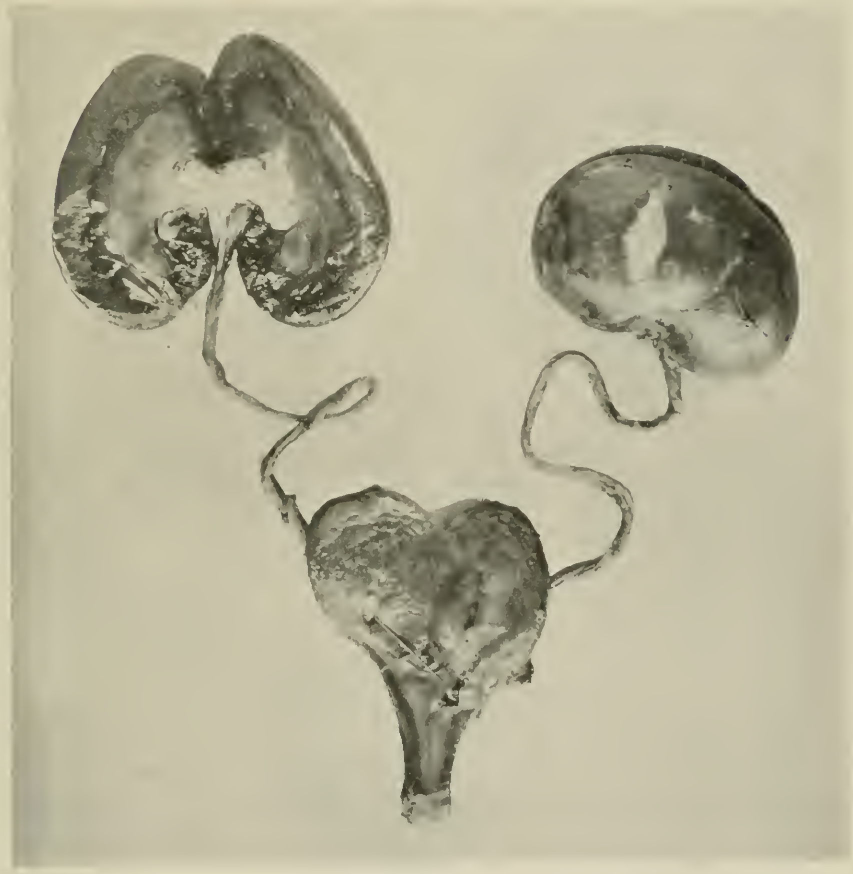

FIG. 3. SPECIMEN OF A DIATHERMY BURN OF THE RIGHT URETERAL OPENING OF A BLADDER OF A DOG TWELVE WEEKS AFTER OPERATION

The right half of the trigone is composed of an indurated, firm, grayish white scar. The ureteric opening on the right side which had been burned back for a distance of 2 cm. was still functioning normally, although it was surrounded by scar tissue. The ostium is contracted to a pin-point size. The scar tissue occupied the entire thickness of the bladder wall.

First: *Total destruction with thermic electro-coagulation.* By this means the neoplasm is literally "burned up" or eschared.

Second: *Low degrees of heat.* By this method, the tumor is not eschared but the degree of heat produced is below the point of carbonization.

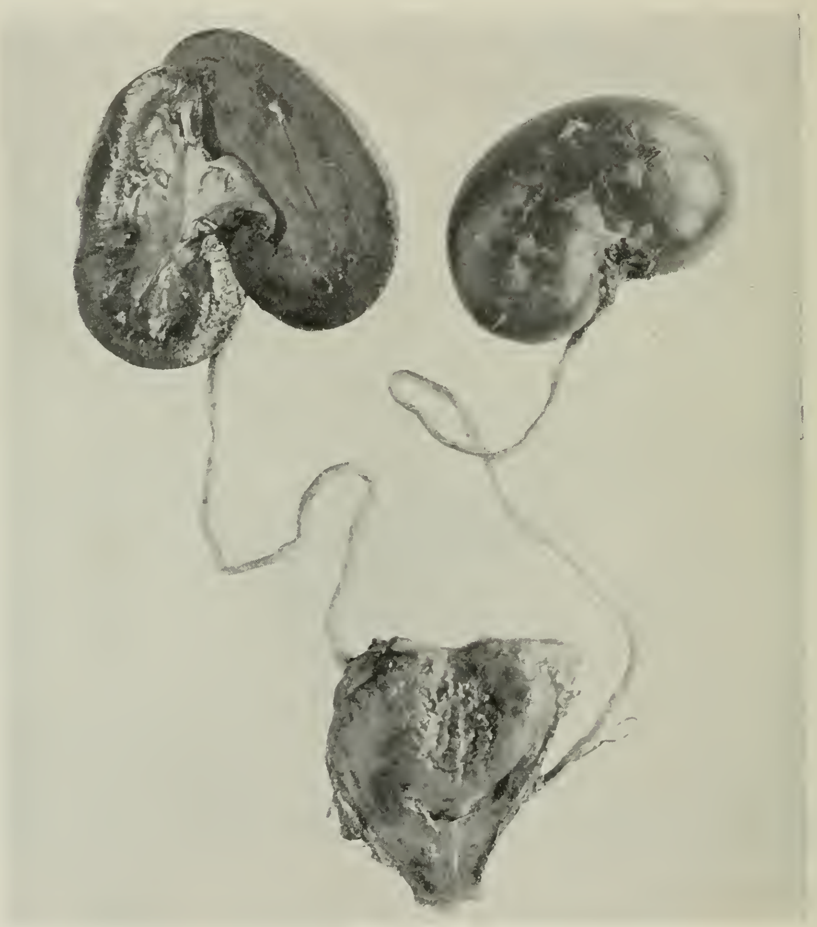

Fig. 4. Specimen of a Right Ureteric Opening of a Bladder of a Dog Twenty-one Days after Diathermy Burn

The right half of the trigone is replaced by grayish, firm scar tissue. The right ureteric orifice is 1.5 centimeters posterior to the normal position and the ostium, which opened in the scar-bearing area, is not contracted or obstructed over this area. The scar occupies the entire thickness of the bladder floor.

We have then a most potent force in diathermy, producing heat in the depths of the tissue. Our inability to control the temperature, however, makes its application uncertain unless total destruction is desired.

The possibility of controlling the temperature in destroying neoplasms of the bladder is afforded by placing a thermometer in the rectum or vagina. This technic will be described later.

In my original contribution (2), I reviewed extensively the history of diathermy.

In this previous communication, I reported the experimental work on dogs which showed how easily and quickly tissue can be destroyed by thermic electro-coagulation.

The immediate effect is a slow "cooking through" of the underlying tissues, the effect upon the deeper structures being the same as that upon the mucosa. This is followed by an aseptic death of the submucosa and muscularis. Round-cell infiltration is marked only for the first three days.

Eventually this entire area is replaced by a dense proliferation of fibrous tissue which is nature's most formidable defense in the destruction of the cancer cell, and the line of demarcation between the treated area and the surrounding normal tissue was definitely preserved.

The ureteral wall may be "burned back" in the dog almost to the entrance of the intra-mural portion. The results in three dogs under observation from three to five months have shown no derangement of function in the ureteral activity or the contractility of the bladder. No obstruction to the ureteral outflow occurred in five months. Clinically, I have cases of from two to four years' standing in which I successfully coagulated tumors on or about the ureteric orifice without subsequent ureteral obstruction.

DIAGNOSIS

As the prevention of metastasis should ever be in mind in the treatment of tumors of the bladder, the indiscriminate practice of excising a piece of tumor for diagnosis should be condemned. If it becomes necessary to remove a piece of tissue for microscopic study, this should be done by the cautery snare.

The other methods available for making a diagnosis of bladder tumors are cystoscopy, palpation and roentgenography.

J. T. Geraghty (3) was among the first to call attention to some of the different cystoscopic findings that are pathognomonic of malignancy.

To the careful urologist, a detailed correlation of the different steps in the various procedures is not necessary.

I believe that by careful and intelligent cystoscopy and roentgenography a sufficient knowledge of the local condition can be obtained. By avoiding any cutting procedure in the removal of tissue for diagnosis, the possibility of metastasis at this time is prevented.

TREATMENT

A careful review of the literature points to the fact that the treatment of bladder tumors by excision is most discouraging. As the treatment of malignant tumors by excision is at best precarious and uncertain, would it not be better to attempt the development of a method that minimizes the possibility of metastases?

I assert that no tumor, whether benign, potentially malignant or malignant should be removed by excision.

If diathermy is not available, the electrically-heated soldering iron is far superior to any cutting procedure.

Diathermy has a distinct advantage over all methods used in the destruction of tumors, whether benign or malignant, for the following reasons: It is absolutely bloodless if a flat or blunt electrode is used.

It not only insures the total destruction of the mass, but also sufficient coagulation of the tissues in the immediate neighborhood to minimize the possibility of cell implantation.

Vascular structures situated near the vicinity are sealed, thereby lessening absorption. On this account, a shorter convalescence is insured.

On account of the extensive formation of scar tissue that is formed after the use of diathermy, nature's method of limiting the spread of the malignancy is enforced; as a consequence, the neighboring embryonal cells are destroyed.

With the development of more accurate instruments for measuring the degrees of heat produced by diathermy, the destruction of neoplasms by lower degrees of heat becomes possible.

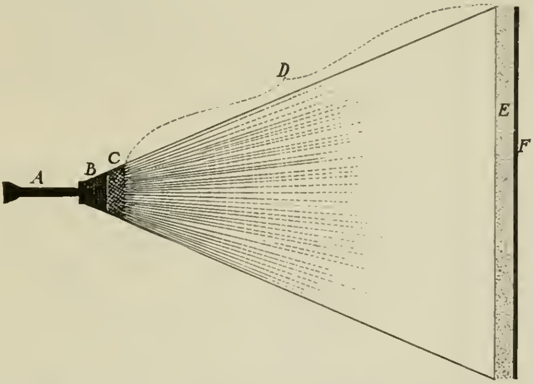

Fig. 5. Diagrammatic Representation of What Occurs under Active Electrode in Surgical Diathermy

a, ¼-inch active disc electrode; *b*, tissues visibly coagulated to a depth approximately equal to the diameter of the disc electrode used; *c*, area of tissues in which the current density has been insufficient to cause coagulation, but has probably been sufficient to destroy the vitality of the cells; *d*, gradual diminution of current density and heating effect; *e*, thick, pad of gauze saturated in warm saline solution (1 ounce salt to 1 pint water); *f*, large indifferent metallic electrode. (Reproduced from Diathermy in Medical and Surgical Practice, by Claude Saberton.)

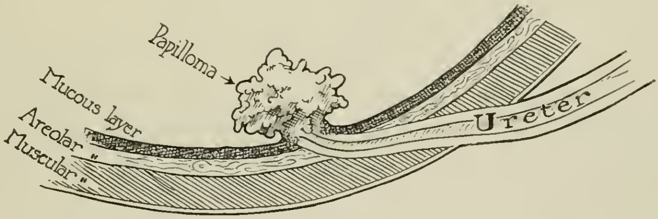

Fig. 6. Diagrammatic Drawing Showing Ureter Passing Through the Bladder Wall; with Its Ostium Obstructed by a Papilloma

Our idea should be, to strike once, if possible, making every effort to have the first attack a complete success in the destruction of the tumor. With this idea in view, the following is recommended:

1. Benign papillomata where few are present and these easily accessible

Transurethral thermic electro-coagulation with as large an active electrode as is possible to pass through an operating cystoscope insures the maximum amount of heat that it is possible to deliver into the depths of the tissues. This is followed by the transurethral application of radium with some special radium applicator.

It has been our custom to coagulate the papillomata, then await developments. This I believe to be a mistake, as they may all be potentially malignant. It seems to me that the prophylactic application of radium may be an additional means that would destroy a latent malignancy. However, in the open method of attack by suprapubic cystotomy, when the thermic effects of diathermy are more accurately controlled, the use of radium is not necessarily indicated.

2. Multiple benign papillomata and those tumors that are inaccessible transurethrally

If suprapubic thermic electro-coagulation is performed carefully and carbonization does not take place, there should be sufficient heat penetration in the depths of the tissues to destroy any possible malignancy.

3. Carcinoma

These tumors are treated by the same method as multiple papillomata, only the thermic electro-coagulation is used more intensively (longer and deeper).

TECHNIQUE

When it is desirable to eschar the tumor mass, chloroform should be used as an anæsthetic. If either gas-oxygen or ether is used, great care should be taken to avoid short-circuiting by having all parts of the electrodes thoroughly insulated.

For a description of the preparation of the patient and operating table, reference is made to my previous article on the subject.

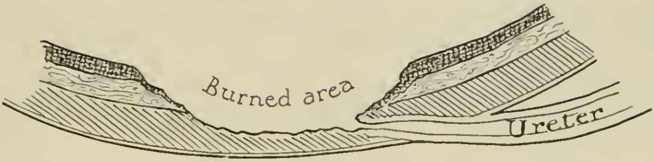

FIG. 7. THE SAME VIEW SHOWING HOW THE URETER IS "BURNED BACK" BY MEANS OF DIATHERMY, INCLUDING REMOVAL OF THE PAPILLOMA

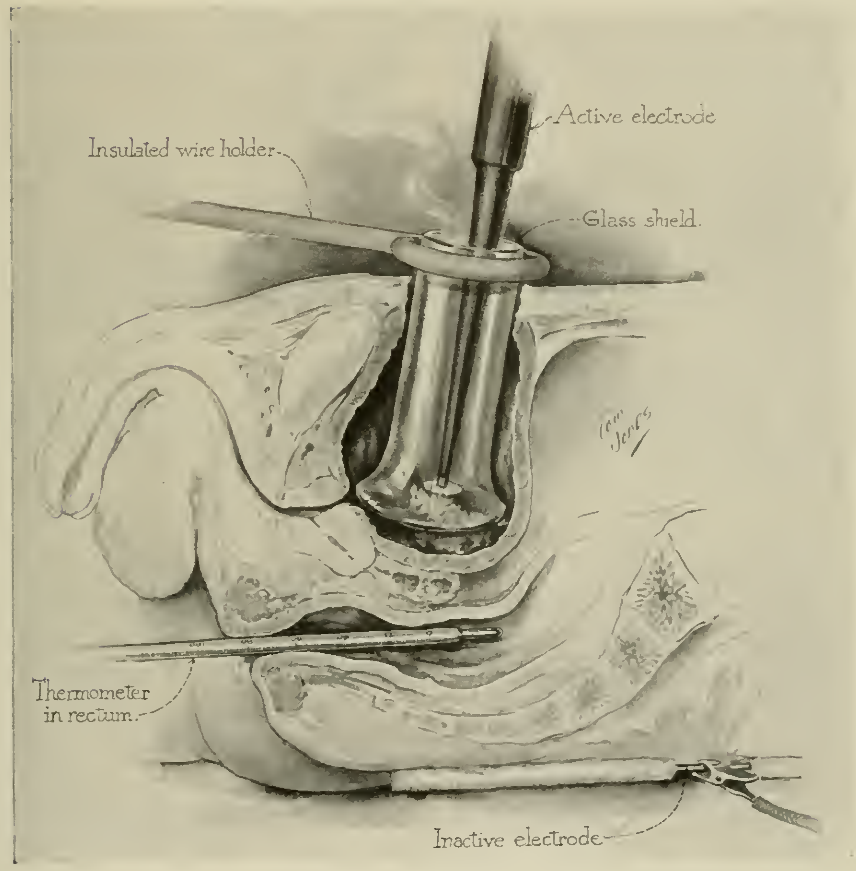

FIG. 8. ILLUSTRATING THE ACTIVE AND INACTIVE ELECTRODES, THE GLASS SPECULUM WITH THE INSULATED WIRE HOLDER AND THE THERMOMETER INTRODUCED INTO THE RECTUM BENEATH THE SITE OF THE TUMOR

In using *low degrees of heat*, we have found that twilight sleep, combined with local anæsthesia, offers the best and safest method of applying diathermy.

As a consequence we prefer this to the more rapid method.

After a preliminary cystotomy, retractors are introduced and a careful survey of the bladder is made.

During the electro-coagulation of tumors situated on the base of the bladder, there is a possible danger of perforating the rectal wall. By the introduction of a thermometer into the rectum in male patients and into the vagina in female patients, the exact temperature at the points of contact of the thermometer is definitely known.

The current is turned on very gradually. This insures a slow coagulation of the growth, at the same time the temperature as indicated by the thermometer can be carefully watched, and the danger of perforation avoided.

The bladder is closed after the method of Pilcher with a dePezzer catheter drain. We have followed the practice of establishing a permanent fistula for several months, our idea being, first, to put the bladder at rest; second, for inspection from time to time by suprapubic cystoscopy; third, in case of a recurrence to have the tumor easily accessible for a second application of diathermy.

Tumors involving the ureteral ostium

The method of "burning back" the ureter, when the orifice is involved in carcinoma, is the easiest and most efficient means of destroying the growth, at the same time preserving the ureter without resorting to any cutting procedure—*the one thing to be avoided in the treatment of cancer.*

Carcinoma of the penis

Destruction of the neoplasm by actual burning or a slow infusion of heat may be resorted to. The most important step in the elimination of the growth, is the destruction of the malignant cells in the regional lymph glands, and in the lumbo-sacral region.

This may be accomplished by placing the large indifferent electrode over the sacrum and the flat active electrode immediately over the glands. Sufficient heat is infused to destroy the malignancy, the heat travelling in a straight line from the inactive electrode over the sacrum to the active electrode over the inguinal glands.

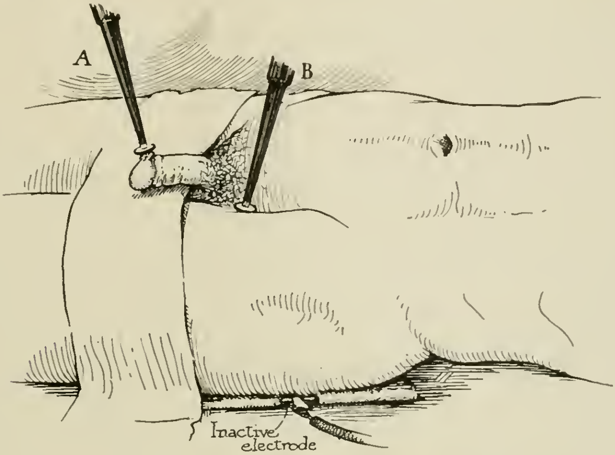

Fig. 9. Illustrating the Active and Inactive Electrodes, the Active Electrode A at the Site of the Tumor, the Active Electrode B over the Inguinal Glands

CONCLUSION

Diathermy can be used to destroy cancer in areas that are totally inaccessible by any other procedure.

In order to accomplish successfully the destruction of malignant tumors with thermic-electro-coagulation we must use a current that is low in voltage and high in amperes, only enough voltage being used to drive the current through the tissues. This, of course, varies in different parts of the body.

In coagulating tumors of the bladder by the low infusion of heat 1500 milliamperes are as a rule sufficient.

REFERENCES

(1) Percy: Jour. Amer. Med. Assoc., 1914, xliii, 1631–1634.
(2) Corbus, B. C.: Surgery, Genecology and Obstetrics, November, 1921.
(3) Geraghty, J. T.: Southern Med. Jour., 1920, xiii, 511.

THE TREATMENT OF CANCER OF THE BLADDER BY RADIUM IMPLANTATION[1]

GEORGE GILBERT SMITH

From the Collis P. Huntington Memorial Hospital, Boston

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In a previous paper (1) the writer described his experience in the treatment of cancer of the bladder by means of the application of radium to the surface of the growth. He concluded that in his hands this method had been unsatisfactory; that a better method consisted in the implantation of radium-bearing needles or of bare tubes of radium emanation directly in the tumor. No priority is claimed for this idea; in spite of the fact that the Huntington Hospital in Boston was the first to use bare emanation tubes in the treatment of cancer in other localities, the writer did not employ them in cancer of the bladder until November, 1919. Since that time practically all of the cases with this condition, coming to the Huntington Hospital, as well as several others at the Massachusetts General Hospital and in private, have been treated by the implantation of radium unless they were altogether hopeless. The results, very encouraging in some cases, discouraging in others, seem worthy of discussion.

The main facts concerning the action of radium upon the tissue in which it is buried are well known. An excellent account of what happens is given by Daland in his paper (2). When a bare emanation tube of 1 or 2 mc. is embedded in tissue, a complete necrosis of the tissue immediately about the tube is caused. This area is perhaps 3 or 4 mm. in diameter. Daland says:

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[1] Read before the American Urological Association, Atlantic City, April, 1922.

Outside of this zone of necrosis, there is an area in which there is swelling of the epithelial cells, vacuolation and edema of the cytoplasm, and amitosis, hypochromatism and karyorrhexis of the nuclei. Accompanying this, there is capillary congestion, infiltration by lymphocytes and leucocytes, and around the periphery further infiltration by fibroblasts. All of these changes occur over an area 1 or 2 cm. in diameter. The central necrosis is the effect from beta and gamma radiation, while the peripheral changes are due to the gamma effect alone.

An important point to be considered is the formation of a fibrous zone at the outer reach of the gamma rays. This layer entangles the cancer cells even if they are not killed, and probably prevents their extension along lymphatics.

This condition is well illustrated by a microscopic section which we had made from a case of cancer of the bladder. In August, 1921, 2 seeds of 2 mc. each were inserted into an elevated carcinoma, by 2 cm. As recurrences developed rapidly in other parts of the bladder, a total cystectomy was done February 7, 1922, about six months after the implantation. Gross examination showed a depressed, fibrous feeling ulcer, about 1 mm. in diameter, in the region of the implantation. Sections through this show a loss of mucous membrane; beneath the ulcer is an infiltration of leucocytes; beneath that, a layer of dense connective tissue. Here and there in this tissue are islands of epithelial cancer cells, but they are vacuolated and the nuclei are spindle-shaped instead of being full and round. There are bundles of muscle fibers at the edge of the connective layer, in places penetrating it; the muscle cells appear normal.

The radioactivity of a tube containing 1 mc. of radium emanation gradually decreases until, after six days, the tube becomes practically inert. The number of mc. hours given off by such a tube is estimated to be 132, and is sufficient to destroy 1 cc. of tissue. A radium-bearing needle containing 5 mgm. of the element will, in our experience, accomplish the same result if left in for twenty-four hours, thus giving 120 mc. hours. It is to be remembered that a large percentage of the beta rays are screened out by the steel of the needle, but the penetrating gamma rays are much stronger than those given off by a seed of 1 or 2 mc. It would seem that for this work, numerous needles containing 5 mc. each would be more efficacious and would bring about a more even necrosis, than fewer needles containing larger amounts of radium. The larger the amount of radium in a needle, the greater distance do the gamma rays have lethal power. So far as we have been able to observe, a 5 mgm. needle exerts practically as much effect upon the tissue in twenty-four hours as in forty-eight hours.

According to our observations, if "seeds" of 1 or 2 mc., as bare tubes of emanation are called, or 5 mgm. needles, are implanted about 1 cm. apart in a tumor, the intervening tissue will be totally devitalized and converted into a white, fibrous slough. This slough begins to become apparent within a fortnight; in two months it is well developed. More or less infection supervenes; the amount of infection varies with the individual. In several of our cases, it was the cause of death, six or seven weeks after the implantation. Old and feeble patients, naturally, are more affected. To avoid such an unfavorable reaction, one must estimate the ability of the patient to resist infection, and in the less favorable cases, use a smaller dose of radium, drain the bladder longer after operation, support the circulation, and promote diuresis.

The reaction about the area treated with radium is usually discernible on rectal or vaginal palpation. The tissues are more or less tender; there is a boggy induration quite different from the stony hardness of malignant infiltration. In cases treated with too heavy doses this induration may persist for six months or more. Usually it clears up in three months. In our cases in which the area radiated was 2.5 cm. or more in diameter, the slough, surrounded by a zone of red and elevated edema, persisted for at least three months. Soon after that it began to clear up.

The cases of cancer of bladder suitable for this method of treatment may be divided into two classes; small, solitary, superficial papillary carcinomata, such as we see only too often recurring after the radical removal of a cancer, which do not respond to fulguration; and sessile carcinomata which are not so situated as to be easily removed by partial cystectomy, and which are limited, in a general way, to a diameter of not more than 3 cm. True infiltrating carcinoma of the bladder wall, if more extensive than that, is usually beyond relief by any means. If so large an area is made necrotic by radium, moreover, the resulting toxemia is very likely to bring about the the death of the patient. Extensive superficial carcinomata are not well suited to treatment by implantation of radium for the same reason, i.e., to destroy the growth, the radium must cause necrosis of the bladder mucosa; too extensive a necrosis is dangerous.

A carcinoma measuring 3 cm. in diameter, involving the entire thickness of the bladder wall, can be so destroyed that the mucosa of the bladder will grow over the area formerly occupied by the tumor, and the induration which before treatment was palpable by rectum or by vagina will disappear. It is not claimed that every cancer cell within this area will be destroyed. It may be that the growth will recur later. As an immediate result, in certain cases a clinical cure will take place, so that six months after, the only sign of the previous condition will be a smooth, cicatricial area in the bladder wall.

This result was accomplished in three of our cases: In case T. D., 10 seeds totalling 24 mc. were implanted. As each seed yields about 132 mc. hours before it becomes inert, the total number of mc. hours was 3168. In case A. T., 12 seeds totalling 32 mc. (4224 mc. hours) were used. In a third case operated upon by Dr. Chute, into a cancer measuring 2 × 2 cm., situated upon the trigone, were implanted 5 needles, each containing 5 mgm. radium. These were left in for forty-eight hours, a dosage of 1350 mc. hours. The tumor was entirely destroyed, so far as could be ascertained. The patient, a man of eighty, made a good recovery, and subsequent cystoscopy ten months after operation showed a perfectly smooth trigone, with no induration perceptible by rectum.

Our method of applying radium in cancer of the bladder has been by intravesical or transvesical approach in small tumors, and by cystotomy and implantation under full sight in more extensive growths. In 3 cases in which numerous recurrences appeared following partial cystectomy, we have implanted seeds in the bases of small tumors by means of an operating cystoscope through which was introduced a flexible needle-pointed seed carrier. The needle point was driven into the tumor, and as it was being withdrawn, the seed was deposited in the tissues by means of a stylet, which expelled the seed from the needle. This method has decided limitations; it is not easy to inject the seeds into resistant tissue. The method is of value chiefly in putting seeds into the bases of low, bushy papillary carcinomata, where the bladder wall appears to be not much involved. In 1 case, previously reported, a papillary growth, partly necrotic and therefore presumably malignant, arising from the anterior bladder wall close to the prostate, was entirely destroyed by passing a steel needle containing 68 mc. emanation through the prevesical space and so into the tumor. The position of the needle was observed through the cystoscope; it was left in place for three hours. One year later cystoscopy showed no sign of growth in the bladder. In another case a needle was passed through the vesico vaginal septum into a tumor situated upon the trigon close to the sphincter.

When the growth is too extensive or too deeply infiltrating to be destroyed by 1 or 2 seeds, we have thought it better to open the bladder widely enough to give a good exposure of the growth. Every precaution is taken to prevent the implantation of cancer cells in the wound. The tumor, if it projects more than 0.5 cm. above the bladder wall, or if it is papillary in type, is cauterized down to the level of the surrounding bladder surface. Seeds are then implanted by means of straight hollow needles furnished with stylets. A row of seeds is implanted about the periphery, about 1 mm. inside the edge of palpable induration, and about 1 cm. apart. A few more are implanted into the center of the growth. The depth at which these are implanted depends upon the thickness of the induration. If the latter is 0.5 cm. thick, they are put just beneath the surface; if it is 1 cm. thick, alternate seeds are implanted more deeply. It is to be remembered that the tissues in the center of the area so treated will die of lack of nourishment, provided a zone of exudate can be formed about the periphery of the growth, even if they are not directly killed by the rays from the radium. The bladder and wound are then washed with 95 per cent alcohol, and a large suprapubic drainage tube left in the bladder for at least two weeks. In some of our cases, a much longer period of drainage would have been better.

A brief summary of the cases treated by us will illustrate the points which we have presented, and will expose some of the pitfalls to be avoided. Only those cases in which cystotomy was done will be considered, as the salient features of the others have been already mentioned.

Case 1. G. McB., male, age sixty-one. December 3, 1919. Operation under spinal anaesthesia. Bladder found filled with four or five sloughing masses of papillomatous tumor. These were removed with cautery and bases cauterized. Two seeds of 8 and 6 mc. were imbedded in the base of the largest growth and a smaller seed in an ulceration above the urethral meatus. March 18, 1920: has gained weight; cystoscopy shows bladder clean, wall normal except in region above and to right of right ureter where there is a sloughing area 2 cm. in diameter, surrounded by a zone of red edematous tissue. August, 1920: cystoscopy shows considerable increase in size of the growth with induration perceptible by rectum. Bilateral uretero-colostomy done. Patient discharged November 24, 1920. Died March 16, 1921.

Case 2. S. R., Jewish woman of sixty-six. November 30, 1920. Bladder opened and a number of seeds implanted in two or three small carcinomata. Seeds varying from 3 to 7 mc. were used, the total number of mc. being 53 to the dosage, totalling 7000 mc. hours. The patient had much pain after operation and three months after operation showed considerable induration of bladder base. Cystoscopy showed much sloughing necrotic tissue in base of bladder. Three or four months later the patient showed a slough of the bladder base which had perforated into the vagina. She gradually failed and died September 16, 1921. I believe that this case had altogether too great a dosage of radium and that her death was due to sepsis from the extensive slough.

Case 3. A. B., feeble old woman of seventy-six. December 21, 1920. Cystotomy. The patient had had a number of radium treatments before operation. The trigone and ureteral orifice were found to be practically surrounded by an ulcerative process covered by grey slough. A piece incised from this showed necrosis and inflammation but no carcinoma. Three seeds of 3 mc. each were implanted on the right side, and 3 needles totalling 44 mc. were inserted into the neck of the bladder and removed in twenty-four hours. The total dosage thus given was about 2200 mc. hours. The patient did well for six weeks, then gradually failed and died. Autopsy showed acute suppurative cystitis, acute suppurative ureteritis, acute pyonephrosis bilateral. No cancer found in any section or in the region of lymphatic glands. In this case the original diagnosis was never proved by microscopic examination although the cystoscopic picture was typical. It seemed probable that the radium treatments given before cystotomy had already destroyed the growth.

Case 4. J. G., woman of sixty-five. August 4, 1921. Cystotomy. On right side of trigone an ulcerated necrotic area, 2.5 by 1 cm. in diameter. Section showed squamous celled carcinoma. Nine seeds of 1 mc. implanted about periphery; 3 of 1 mc. in the center of growth. Two needles, 1 of 60 and 1 of 55 mc. inserted into lower and upper walls of ulceration for seven hours; total dosage 2400 mc. hours. Patient discharged ten weeks later. Cystoscopy at that time showed in the region of right ureter a dense white slough, about 3 by 1 cm., surrounded by a zone of reddened tissue. No induration of bladder base on palpation. A letter received from this patient's daughter states that the patient has been very uncomfortable and has been confined to bed since leaving the hospital. Lately has begun to improve.

Case 5. D. T., male, forty years old. August 30, 1921. Cystotomy. Trigone and right side of bladder neck covered with fairly clean shallow ulceration. Edges are rather elevated and indurated. Section showed carcinoma. Twelve seeds of 1.5 mc. each were buried in the ulcerated tissue; 66 mc. applied to the surface of the tumor for seven and one-half hours. Total dosage 2900 mc. hours. Patient did well for a while but after removal of suprapubic tube did not drain well through catheter. A tube was reinserted but there was much sloughing and the bladder drainage was never very satisfactory. About four months after operation he began to show signs of urinary suppression and sepsis. His left kidney became palpable and very tender. January 11, 1922, a nephrotomy was done on a kidney enlarged to 3 or 4 times its normal size, and studded with abscesses, but the patient died later that same day. In this case suprapubic drainage should have been continued over very much longer time than it was. An earlier nephrotomy might possiby have saved his life.

Case 6. W. H., healthy man of forty-four. September 3, 1921. Cystotomy. Right lateral wall of bladder showed two elevated areas, size of almonds. Into these were put seeds of 2 mc. each. No other areas of carcinoma were recognized although several superficial ulcerations were seen. One of these was excised and proved to be carcinoma. Carcinoma recurred throughout the bladder and in February total cystectomy was done following the implantation of the ureters into the bowel. Patient eventually made a very good recovery, somewhat delayed by a fecal fistula. The area treated by radium is described earlier in this paper.

Case 7. Woman of sixty-five. October 11, 1921. Cystotomy. Severe cystitis with phosphatic deposits. On right lateral wall is a sloughing growth with indurated base. The induration extends over an area about 4 cm. in diameter. Ten seeds each of 2 mc. were implanted in this area. Through the vagina 2 seeds of 4 mc. each were implanted into the indurated area. Patient did well for two weeks and then became very irrational and gradually lost strength and died November 10, 1921. No autopsy was permitted. This case was rather too advanced for treatment although the relatives were very desirous that something be done.

Case 8. T. D., shoemaker of forty-three. November 9, 1921. Cystotomy. On right lateral wall close to prostate is a sessile, ulcerated, slightly elevated growth, about 2.5 cm. in diameter. Right ureter was apparently included. Section showed carcinoma. Round periphery of growth were implanted 6 seeds of 2 mc. each and 3 seeds of 3 mc.; 1 of 3 mc. implanted in center. The total dosage 3192 mc. hours. Convalescence was uneventful except for what proved to be a right pyelonephritis. Discharged December 22, 1921. March 16, 1922; patient feels perfectly well and is back at work. Urine is slightly cloudy. Cystoscopy; right lateral wall of bladder covered with healthy appearing mucosa. One depression is visible. No edema. No sign of new growth. Rectal examination; no induration of bladder base perceptible.

Case 9. C. W., farmer of sixty-one. Operated on January 26, 1921 at M.G.H. by Drs. Barney and Smith. Had necrotic growth, size of hen's egg, rising from left of trigone; practically filled bladder. Was cauterized off; seemed fixed. 7 seeds of 1 mc. each implanted in base. Section showed carcinoma. Discharged one month later. Two months after operation showed in region of tumor a white sloughing area surrounded by zone of reddened edema. Man still had considerable frequency.

Case 10. A. Y., carpenter of sixty-three. Cystoscopy February 10, 1921. Slightly ulcerated growth in the left lateral wall of bladder about 3 cm. in diameter. Induration seems to extend through bladder wall and is palpable by rectum. Section shows carcinoma. Twelve seeds varying from 1 to 4 mc., total 32 mc., implanted into growth. Patient made a good recovery. Ten weeks after operation there was still considerable cystitis. The slough over left side of bladder had almost entirely disappeared. August 18, 1921: Patient back at work. Left wall of bladder practically healed over. January 19, 1922: Patient says he is in the best of health. Holds urine all night and for three hours in the day. Urine is slightly hazy. Cystoscopy shows a clean and smooth bladder. No evidence of malignant disease. No induration felt by rectum.

Case 11. E. B., man of eighty. A case of Dr. Chute's. May 14, 1921. Cystotomy. Drs. Chute and Smith. On the trigone was found an elevated, sessile growth about 2 cm. in diameter. Section showed carcinoma. Into growth were inserted 5 needles each containing 5 mgm. of radium. These were left in for forty-eight hours. Patient made a very good recovery. Suprapubic drainage removed in two weeks. Cystoscopy on March 11, 1922, showed the bladder clean and smooth with no sign of new growth.

CONCLUSIONS

1. The implantation in bladder cancer of bare tubes of radium emanation of low potency, or of radium-bearing needles of 5 mgm. each, will cause complete necrosis of the tumor, provided

they are inserted 1 cm. apart and are so placed that the entire periphery of the growth is brought within reach of rays of lethal power.

2. Two classes of cases are suitable for this treatment: small, single papillary carcinomata into the base of which bare emanation tubes may be deposited by intravesical methods; sessile carcinomata, or the bases of large fungating growths after destruction of the tumor by cautery, into which radium may be implanted through a suprapubic cystotomy.

3. It is inadvisable to bring about the necrosis of a tumor more than 3 or 4 cm. in diameter, as the absorption of toxins from the infected slough is likely to prove fatal.

4. The problem in treating cancer of the bladder by this method is to use enough radium to destroy the cancer, but not enough to destroy the patient.

5. A number of cases of cancer of the bladder in whom the growth could not have been excised successfully, have shown complete disappearance of the growth, clinically, following the implantation of radium.

REFERENCES

(1) Smith, George Gilbert: The use of radium in cancer of the bladder. Surgery, Gynecology and Obstetrics, November, 1921, 570.

(2) Daland: The A B C of radium. Boston Med. and Surg. Jour., June 30, 1921.

A NEW METHOD OF APPLYING RADIUM THROUGH THE CYSTOSCOPE[1]

LEO BUERGER
New York

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Although many devices have been proposed for the intravesical, endoscopic, or non-operative application of radium, none other than the introduction of radium emanation tubes has been altogether satisfactory.

The ingenious cystoscopic devices of Young, Corbus and others, necessitate the retention of the cystoscope in the bladder during the period of application. The radium capsule is enclosed in the tip or beak of the instrument, which portion is placed in contact with the tumor over extended periods of time. What with the motion due to respiration, the restlessness of the patient and our fear of radiating the normal parts of the bladder, there are enough factors of uncertainty to make even some ardent radium enthusiasts skeptical as to how much can be accomplished in this way.

In our own work with radium in the treatment of carcinoma of the bladder, the best results have been obtained with the use of radium emanations with the coöperation of Dr. Isaac Levin, introduced through a suprapubic incision. Where, for particular reasons, intravesical application is advisable either in the preparation for future operative work, or as a method of preference, emanations are also considered to possess the greatest advantages. They can be easily inserted through the author's operating or radium cystoscope.

However, this ideal procedure is available to but very few urologists. It has been my purpose to evolve a procedure that would bring an intensive and efficacious method of applying radium within the reach of the cystoscopist; to perfect a method *that will eliminate the necessity of leaving the cystoscope in the bladder,* and thus permit of the prolongation of radium contact over a period of many hours without excessive discomfort to the patient.

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[1] Read before the American Urological Association, Atlantic City, April, 1922.

THE AUTHOR'S METHOD

The armamentarium which has been successfully employed by me is simple, as also the technic of inserting the radium. It includes: First, special radium needles;[2] second, special applicators for the insertion of the needles into the growth[3] and third, either the author's operating cystoscope, a direct or oblique vision cystoscope, or the author's oblique vision radium cystoscope.[3]

The radium needles

Two sizes and types are recommended, steel needles containing 20 mgm. each, and a hollow platinum needle enclosing approximately 50 mgm. of the radium salt.

These have been especially constructed and are of minimum length, so as to be easily introduced either by means of an attachable wire stem or a special spiral applicator.

The needles are composed of two parts, the needle point with shaft (fig. 1, a), and a detachable eye (fig. 1, b). This arrangement permits of two methods of introduction, namely, with a wire shank or in a spiral applicator (fig. 2).

The needle point is short and is an integral part of the radium chamber, its proximal end being provided with a female screw thread. This may receive either the eye end, or the male portion of a wire applicator. Thus, such a needle may be introduced into a growth either with an attached wire shank or as a complete needle whose eye receives a fine wire retainer.

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[2] Constructed by the Radium Chemical Company of Pittsburgh, Pa.

[3] Executed by the Wappler Electric Manufacturing Company, New York, according to my designs.

The applicators

Two types of introducer or applicator have been found useful. One of these is a spiral flexible wire shank (32 cm. long) whose distal end is furnished with a metallic cup for the reception of the eye end of the radium needle, and whose proximal end is fitted with a metallic enlargement for the adaptation of the rubber catheter or nipple. The metallic cup is an incomplete cylinder having a longitudinal slot or an aperture through which a holding wire may slip or emerge (fig. 2, a). The needle is threaded with fine wire doubled on itself and long enough to emerge 14 inches beyond the catheter outlet. Or, less rigid, finer wire twisted after being threaded may be found useful. The needles may be subsequently withdrawn by means of this holding wire.

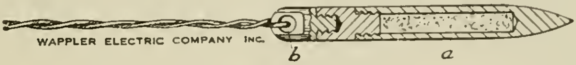

FIG. 1. RADIUM NEEDLE

a, shaft; *b*, eye

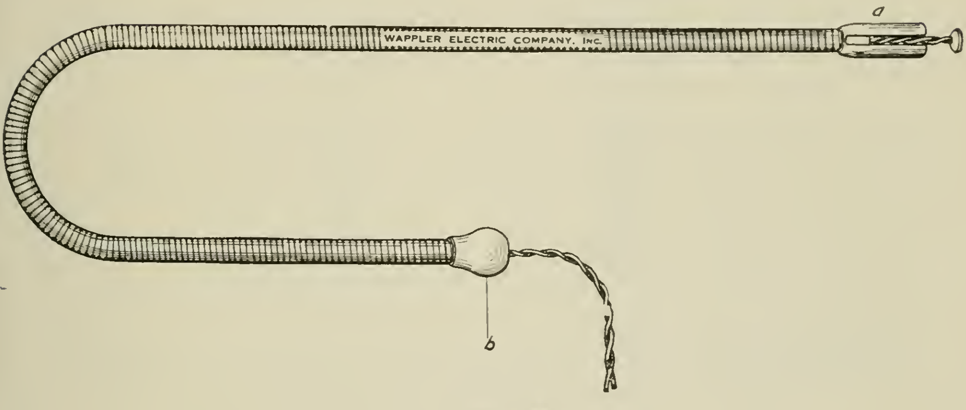

FIG. 2. SPIRAL WIRE APPLICATOR

Contains plunger (*x*), cup-shaped end (*a*), and knob (*b*)

Just before insertion into the cystoscope, the needle with wire threaded is placed into the metallic cup. The wire emerges through the slot or aperture and passes alongside of the spiral shank, and through the rubber nipple at the catheter outlet. A slight pull on this wire suffices to retain the needle in its socket; or the retaining wire may be fastened to the spiral by an appropriate screw clamp.

When this variety of applicator is employed, our aim is to withdraw it, leaving the needle with the wire *in situ,* the cystoscope being then removed.

The *second type* of applicator is intended for those who may find some difficulty in mastering the technic of withdrawing the spiral applicator. It consists of a flexible spiral with a male thread to fit into the female receptacle of the needle, *the eye of which must be removed* before attachment is made. Although this type may appear easiest to employ particularly as far as withdrawal of the cystoscope is concerned, it carries with it this disadvantage, that a heavier stem must be retained in the urethra. This may be objectional in the male, in that movements of the pendulous urethra tend to displace the needle out of the growth.

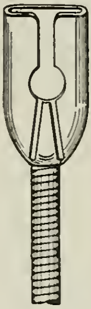
Fig. 3

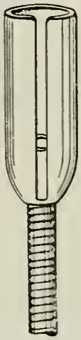
Fig. 4

Fig. 3. Cup-Shaped End of Applicator for Reception of Two 20-mgm. Needles
Fig. 4. Cup-Shaped Receptacle for One 50-mgm. Needle

The *third applicator* is patterned after the first, differing only in the size of its socket or cup, this being designed to carry one 50-mgm. needle of radium (fig. 4).

For those who prefer the simultaneous introduction of two 20 mgm. needles, a special applicator with a broader receptacle carrying two needles in team fashion (fig. 3) may be found to be useful.

For the introduction of *radium emanations* a long flexible spiral wire applicator is recommended. Its distal end is a hollow needle into which the capillary glass emanation tube is buried; and throughout its length travels a wire mandrin that enables the operator to plunge the radium into the growth (fig. 7).

The cystoscope

Ordinarily the author's operating cystoscope would be found adequate, both for the insertion of radium emanations through a special applicator (fig. 7), or for the introduction of one only of the special steel and platinum needles above described.

Under certain conditions, however, we have found the *direct* type of cystoscope, or one with oblique vision preferable. For this purpose, certain modifications were made in the convex sheath usually employed for direct telescopic cystoscopy. Through this sheath, whose fenestra is larger than that usually adapted for catheterization of the ureter, either a direct operating telescope, or an oblique vision telescope may be inserted.

The oblique vision telescope is provided with a special lid or deflector that is placed directly over the objective and is fenestrated in order to permit of vision through it.

The most advantageous type of cystoscope for this work is a special radium cystoscope[4] recently devised by me, an instrument whose mechanism meets the requirements of tumors that are almost inaccessible to the usual varieties of cystoscopes.

Experience has taught the cystoscopist that there are regions in the bladder, which may be called relatively inaccessible as far as intravesical operative manipulations are concerned, although a fairly adequate degree of visual investigation in them is possible. These are the juxta-sphincteric regions behind the sphincter at every point, except at the floor of the bladder. To reach these successfully when invaded with tumor, a special radium cystoscope (fig. 8) has been constructed. It is provided with an unusually large fenestra and a correspondingly long deflector. The purpose of the latter is to attain that maximum direction of necessary appliances that the mechanical conditions at the bladder neck impose. By the long and unusually strong deflector, the resistance of the sphincteric muscle can be overcome, the sphincter displaced and pushed aside, and growths in intimate relation with its distal limbo, brought within reach.

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[4] Executed bythe Wappler Electric Manufacturing Company, New York.

Technique of the application of 20-mgm. needles

After localizing the growth, and after the diagnosis of carcinoma has been established, one or two needles are prepared, each being threaded with fine wire, doubled, twisted on itself, and of a length sufficient to emerge some 2 inches from the spiral applicator. Each needle is placed into its socket. The wire emerges through the slit (fig. 5), or aperture (fig. 6), and is affixed to the shank at the nipple end. Such an applicator with a single radium needle is passed into the telescope, escape of fluid at the catheter outlet being prevented by a large rubber nipple, and through the spiral by a small catheter nipple.

The procedure of plunging the needle into the growth must vary depending upon the type of growth at hand, its size and configuration. Thus, we may desire a tangential application or one perpendicular to the surface. Having introduced the radium needle almost to the eye end, the next step is to release the needle and remove the wire applicator. In doing this we must be careful to prevent dislodgement of the needle as the deflector is released. Whenever deflection is employed for purposes of introduction, its amount must be carefully noted so that a reciprocal motion of the cystoscope may be employed when the lid is put down. For, to release the lid without a complimentary motion of the shaft of the cystoscope may result in a recoil of the wire applicator with consequent pulling out or tearing of the needle through the tumor mass.

Having, therefore, moved the beak of the cystoscope towards the tumor as we lay the lid down, we are then in the position to remove the spiral. In doing this we must simultaneously introduce the wire retainer as the spiral applicator is made to recede.

If but one needle is to remain in the tumor, the telescope is removed first and the sheath follows.

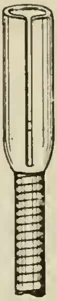

Fig. 5

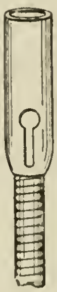

Fig. 6

Figs. 5 and 6. Receptacles for 20-mgm. Needles
Figure 5 with slit; figure 6 with aperture

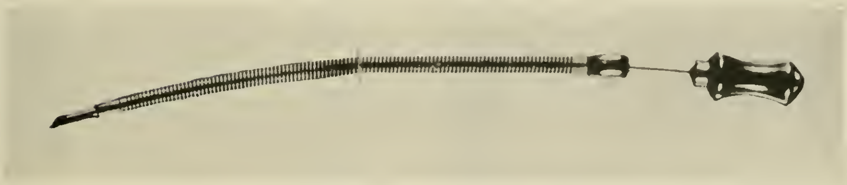

Fig. 7. Applicator for Introducing Radium Emanations Through the Cystoscope

We have frequently resorted to a checking up procedure to verify the situation of the needle after the removal of the cystoscope. A small instrument of 16 or 17 French caliber, threaded over the wire retained is introduced for this purpose. If a second needle is to be inserted, the manipulations are repeated, the wire retainer of the first needle being allowed to emerge through a second hole in the large rubber nipple.

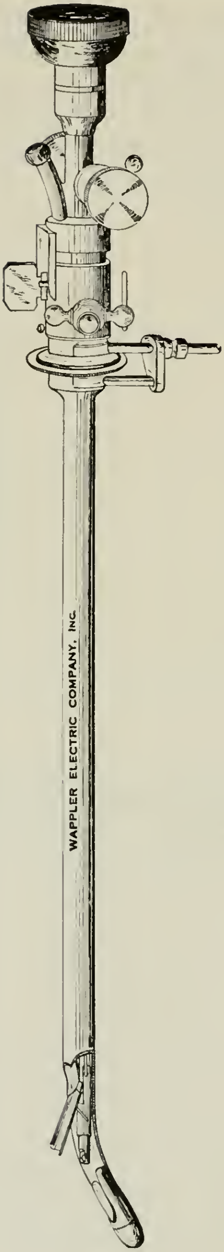

Fig. 8. New Radium Cystoscope with Large Fenestra and Long Deflector

Care must be exercised to prevent dislodgment of the needle already implanted. By leaving enough slack wire in the bladder, an inadvertent tug will not be transmitted to the needle itself.

Concerning the application of these methods in practice

The worker in the field will be required to answer the surgeon's critical query, first, as to whether there is a field for the application of radium through the cystoscope at all, and second, if radium is to be applied, should it not be introduced through the open bladder?

Time will not permit me today to discuss at length all of the correct indications for the use of radium in the bladder. But as a urologic surgeon, and one, who has treated carcinoma of the bladder almost exclusively in a surgical manner for more than fifteen years; one who has been able to witness the results of partial resection with or without ureteral reimplantation, complete cystectomy and cauterization, I can unqualifiedly express the opinion that not only has the cystoscopic application of radium a sphere of usefulness, but that radio-surgery—the combined administration of radium and surgery—is the best therapy at our disposal today for such malignant growths.

As for the cystoscopic radium therapy, its field is three fold: First, for the treatment of carcinoma alone without surgery; second, for the treatment as a preliminary step to surgery; third, for the treatment of metastases.

Cystoscopic radium therapy

There will be three distinct circumstances that may lead us to adopt the cystoscopic methods of radium work. First, the patient by reason of his age, habitus, special prejudices, knowledge of physical mediocrity or what not, will refuse any operative interference.

Second, we ourselves will deem surgical intervention contraindicated for one reason or another.

Third, we will give cystoscopic radium application preference. We need not discuss in detail the first two of these conditions.

Let us dwell for a moment on the third. Our reasons for this choice may be varied. First we may take this view because the growth is small and appears amenable to radiation, but on the other hand is so situated that an extensive operation compromising one ureter and requiring ureteral reimplantation would be the only correct surgical procedure. Second, because, in a given case we feel that we are dealing with that type of small carcinoma which we have heretofore successfully treated with the snare and fulguration alone, but which type is occasionally followed by local recurrences or invasion of the bladder wall. Third, because the growth is in the main a papilloma with evidences of carcinomatous change, is small, is readily accessible, but because of its potentialities for deep infiltration, needs more intensive treatment than fulguration and the snare, even though we have time and time again obtained cures in this type without radium and without surgery. And this feeling, that radium is required, we have acquired through the knowledge of our inability to foretell in advance as to which of the small changed carcinomatous papillomata are already attended with malignant cell invasion of the wall of the bladder, and in which such infiltration is absent.

But to elucidate more in detail: There is a large group of cases in which a small villous or apparently solid growth presents itself and on microscopic examination shows solid carcinoma. But there is no edema about the growth, its pedicle is broad, not over 1.5 to 2 cm., and the cystoscopic appearances indicate no macroscopic invasion of the bladder wall. We do not belong to that school that would advise immediate cystotomy in these cases, for our results have been equally as good with more conservative measures. In the past we have cured a number of these cases with the use of the snare immediately followed by fulguration, or in some by fulguration alone. However, in certain of these a recurrence may occur weeks or months after every macroscopic evidence of growth has disappeared, in the form of solid infiltrating carcinoma. Not knowing how to differentiate growths of such different potentialities, we now feel that we have in radium emanations and penetrative radium needles, therapeutic measures that may prevent these recurrences. Our present approach, therefore, differs from that of the past, in that we treat these small growths either with emanations or radium needles introduced through the cystoscope, giving the former the preference. In view of our experiences we believe that just in this type of small polypoid growth without infiltration, a suprapubic cystotomy carries with it greater risks than advantages. When, however, we are at pains to make the diagnosis accurately, either by reason of imperfect view, inaccessibility of the growth, or lack of experience, then opening of the bladder is to be recommended.

There is another type in which the growth is also relatively small, more distinctively villous, the microscopic sections showing what I have termed "changed papilloma." By that I mean papilloma with undoubted areas of carcinoma. Here, too the procedure recommended is the same, but fulguration may be employed to cut short the growth of the long and multiple villi.

Or, if you have treated a papilloma with fulguration, without knowledge of its microscopic structure some time thereafter you see a small ulcer or solid warty growth over the site of the base, and biopsy reveals carcinoma. Here, too, is a field for the introduction of radium through the cystoscope.

There is an interesting group of cases in which many of us have heretofore done complete resection of the bladder. Reference is made to those carcinomata of the multiple variety in which the primary growth is small and infiltrating, and associated with it throughout the vesical interior there is a varying number of carcinomatous nodules of small size.

Here we recommend suprapubic cystotomy with needling with emanations. But we watch these cases very carefully and by means of the cystoscope attack subsequent nodules. It is remarkable what results can be thus accomplished.

As for the small recurrences after surgical or radio-surgical therapy, these, too, offer an excellent field for cystoscopic radium work. In a case in which the open operation was done some three years ago, I was recently able to destroy one solitary small nodule far removed from the originally affected site, and the patient is comfortable and free from symptoms.

An excellent illustration of the remarkable result that can be obtained by cystoscopic application of radium in carcinoma of the bladder will be given here. The case was, in a sense, experimental as to the method of application of the radium, two types of radium treatment being employed. The patient had refused operative intervention, which was not at all unsatisfactory to me, for, we were dealing with a carcinoma just behind the right ureteral orifice, of the infiltrating variety, that would have necessitated an extensive operation of resection and ureteral reimplantation. The case, from the standpoint of therapy, presents two phases:

First, that of the treatment with metallic radium needles, and second, that of treatment by means of radium emanations.

By means of the first of these methods, it was demonstrated that a shrinkage and disappearance of part of the carcinoma was brought about, and with the second method, the total mass disappeared. With the first method, the peripheral portion of a part of the mass was made to retract and disappear, while with the second or emanation method, the larger part of the tumor was made to necrose, so that at the end of the treatment, no vestige of carcinoma was left.

W. B., age 52, was referred to me on October 26, 1921. He had noticed considerable blood in the urine for about 6 months, which diminished and practically disappeared 6 weeks before consulting me, only to return again. After the first appearance of blood 6 months ago, the bleeding persisted for 6 weeks. Subsequently he had a free interval, but the hematuria recurred, so that recently the blood in the urine gave him considerable concern. With the increasing amounts of blood other urinary symptoms had been superadded, namely, urinary frequency every 2 hours and nocturia, with pain on voiding. He had lost 3 pounds in the last 3 weeks.

Cystoscopy, on October 26, 1921, showed a lobulated infiltrating carcinoma occupying the region immediately behind and somewhat overlapping the right ureter, over an area about $\frac{3}{4}$ inch in diameter. Posteriorly, the tumor extended by a tongue-shaped process for some distance back. The right ureter was closed by infiltration of the ureteral wall, so that a catheter could not be inserted beyond a point 1 cm. removed from the orifice.

First phase of the treatment, October 27, 1921. A 20-mgm. radium needle was introduced into the posterior part of the tumor, penetrating the growth and allowed to remain in 2 hours.

October 31, a 50-mgm. needle was inserted into the tumor mass and left in 2 hours; November 7, 50 mgm. for 1 hour; November 18, 20 mgm. for 3 hours; November 19, 100 mgm. for 1 hour.

November 23, it was observed through the cystoscope that the posterior half of the tumor had almost disappeared, being replaced by a retracted, scar-like area (result of the first phase of treatment).

Second phase of treatment with emanations. In view of the fact that the distal portion of the tumor showed but moderate improvement and some necrosis, it was decided to implant emanations.

December 12, four emanation seeds were implanted into the tumor through the radium cystoscope.

December 30, marked improvement was seen through the cystoscope, there being considerable sloughing of the central portion of the tumor. The posterior part had healed, and was presented by a retracted scar. From this time on, improvement was remarkable, so that on April 8, 1922, cystoscopic examination showed no vestige of tumor.

Between February 11 and 21, 1922, and April 8, several radium treatments were given per rectum by Dr. Levin. February 21, 42.8 mc. for 3 hours; March 7, 84 mch.; April 8, 78.4 mch.

CONCLUSION

1. Certain improvements in cystoscopic armamentarium have been developed that enhance the accuracy of, and increase the potency of intravesical radium therapy.

2. Our results with these new procedures have been so gratifying and encouraging that we hope, in the near future, to be able to report a series of cases, that will bear testimony to the value of the proposed methods; and further to show that in a certain field of carcinoma of the bladder, as good end results are obtainable with the use of the cystoscope as with a combination of radium and surgery.

DISCUSSION.

Dr. Irivin S. Koll, Chicago: I believe, and with gratification, that the vast majority of us have practically discarded resection of the bladder for neoplasms. What the future is going to hold out as to the best nonsurgical method of dealing with these tumors of course remains to be seen—whether it will be the application of diathermy or radium. At the present time we are much interested in the use of electro-coagulation, or diathermy, which Dr. Corbus has so ably described. Before mentioning a few points as to our technic, there is one request I wish to make of Dr. Corbus, and that is that he bring out one point more in detail, namely, the effect of "burning back" the ureter at the ureteral orifice and the spontaneous reëstablishment of function.

At present at the Michael Reese Hospital we have some fifty-odd, the majority belonging to Dr. Kolischer cases of carcinoma of the bladder that I feel have given us excellent results from treatment by electro-coagulation or diathermy. This has extended over a period of about three years, and while I have not time to go into detail at this time, they will be reported in detail later.

Our technic, briefly, is the opening up of the bladder and recently, in a few cases, in incising the bladder I have made a transverse incision in the bladder wall for the reason that I feel it gives a better exposure and is easier to suture, because we close our bladders without drainage in most instances with impunity and feel much gratified in doing so.

The application of the diathermy is made through some special applicators, a number of which we have now obtained that are constructed at different angles to meet the situation of the tumor. These applicators are made of copper and the sparks are first rained down upon the neoplasm, then burned by dried application. If we have a tumor mass on the lateral wall we have applicators at that angle. Some are very small, having only three prongs, and some have six or eight. Some are circular with prongs projecting from all directions.

Following the surgical procedure, within twenty-four or forty-eight hours, the patients receive massive doses of X-ray. We do not use radium.

This is only a preliminary report but we are much gratified with our results and I would like to have some of you try this method so that within the next year or two we can compare the results of the radium application and the diathermy without radium.

At present I am engaged in some research work in the hope of standardizing the application of diathermic heat. We are trying to work out on dogs a method by which we can measure the degree to which we are applying the heat and the reaction of the tissues in the environs of the burn.

Dr. MAX LAUTERMAN, Montreal: This has been one of the most fruitful subjects we have had the good fortune to be favored with at this meeting. It is gratifying to me to have been familiar with this work from its inception. I think we had first Nauglesschmidt, later Guyon, and later d'Arsonval and not forgetting Beers, who did outstanding work. I, like many of you, have run the gamut. I recall the time when I thought that resection offered the only possible solution for malignancy in the bladder. If the growth was not malignant the patient got well and if not, owing to many things that pertain in the mind of the pathologist—because the personal equation obtains there as well as in other places— many cases that were reported as successfully cured of malignancy were only mildly so, if at all. That influenced men in their opinion, but a new era is dawning and I am sure that before long a new method will be worked out, on the work so well described by Corbus and in the electro-coagulation, with which I have no experience.

One statement I wish to take issue with; that is, the statement in which he says that fibrous tissue is Nature's most potent defense against cancer. My appreciation of the situation is that the development of fibrous tissue is a response to irritation and because of its low vitality I have never been able to feel that it is a defensive measure. If Dr. Corbus can elucidate that point I shall be grateful to him.

One point I think worthy of emphasis is his insistence on low voltage and high amperage. It may interest you to know that out methods are passed on to men who are not situated to correctly treat these cases and these points which are familiar to us are not recognized.

I agree with Dr. Corbus as to removing pieces for examination. Unfortunately, as a rule, we only get a particle off the top of the growth and that is not where one finds the evidence of malignancy. The true thing is to regard every growth in the bladder as potentially malignant, if your experience has been anything like my own.

With electro-coagulation, as developed especially by Guyon, you will agree that these growths can be cured by this method. If you follow the high amperage and low voltage you will not have any of the unfortunate effects that follow an imperfect technic. We have had our failures with excision.

Dr. Koll mentioned something that is really important, and that is the character of the electrode. I do not know whether it is generally known that silver is a much better conductor than copper. I have had a series of electrodes made of pure silver and think they are much better than any other type of electrode I am familiar with and give better results. I think you will acknowledge this great advantage if you will try them.

The infiltration with X-rays after any other form of treatment is, I believe, one of the best and most reliable adjuncts we have to any form of treatment, especially after diathermy.

Dr. Arthur L. Chute, Boston: I have had one case that should be spoken of in connection with Dr. Smith's paper to which I called attention previously. He was operated upon for an infiltrating growth of the bladder in 1917. We removed the mass on the bladder base, cauterized it with the actual cautery, and later put radium emanation into the bladder twice. This man made a miserable convalescence and for months had a very badly irritated bladder. Now, five years later, he is without symptoms and apparently perfectly well; I met him on a railroad train about two weeks ago. At the time of operation he was fifty-three years of age.

Dr. Joseph F. McCarthy, New York: In 1912 or thereabouts, I read a paper at a meeting of the American Urological Association held at the Hotel Astor, where the method of destruction of bladder tumors by means of the d'Arsonval current through the open bladder incision was first reported. In the first case wherein the method was employed by us the patient died after a week, and the bladder removed was found to be apparently free of any evidence of growth, whereas, at the time of operation a very extensive caracinomatosis of the bladder existed. We then thought we had a panacea for such condition.

Subsequent animal experimentation by Dr. Francis Carter Wood discouraged in some measure our efforts along this line, and we have practically dropped the procedure excepting in a few selected cases. A brief discussion with Dr. Corbus has led me to believe that our treatment was perhaps insufficient and not carried out with the perfected method recommended by him.

I would say a word of caution concerning growths about the ureter from which vegetative processes may seem to emerge, and would suggest to Dr. Corbus, that he do not overlook the possibility of renal pelvic growths as such a picture is exceedingly suggestive of this condition.

Dr. Granville MacGowan, Los Angeles, Cal.: This subject has interested me a great deal because it is a pet one of mine. In the beginning cancer is always a local disease, and so long as it is a local disease it is easily cured if you will attack it with sufficient vigor and by means that will not spread it and favor metastases. There is no difference whether it is on the skin or in the bladder. I will except that if it be situated in glands, like the breast, it is doubtful whether it is ever susceptible to positive cure, although clinical cures sometimes seem to be acquired. But I believe, in the neck of the uterus, in the bladder, anywhere on the skin, in the mouth or anywhere readily accessible, if it is not attacked with a knife, it may be cured. It should be attacked with electro-coagulation or an electric knife, something that seals the lymphatics and the blood vessels, when, if you do not handle it roughly—if you do not squeeze it and put snaps on it, if you do not insult it—in the great majority of cases the cancer will get well.

So far as the bladder is concerned. Years ago I abandoned the use of the knife for the removal of tumors of the bladder, malignant or otherwise, unless driven to it by the absence of other measures to use, or if it were situated at the tip of the bladder where one can remove as much of the bladder as one liked, a fourth, a half or two-thirds and years afterward have a bladder that will hold 10 to 16 ounces.

I was very glad to hear the paper of Dr. Corbus because I have had much success in destroying tumors of the bladder, malignant or not malignant, by dessication. I do not believe it is necessary to use a thermometer in the rectum. The gloved finger of an assistant held there while one uses the d'Arsonval current removing the charred tissue as the operation proceeds so that there is always fresh tissue in front of the electrode, is a perfect protection. The finger of an intelligent assistant will tell you much better than a thermometer when you should cease directing the rays toward the rectum. Guyon many years ago proved that in cases of cancer of the bladder Nature forms a cellular fat layer in front of the tumor as it infiltrates toward the outer bladder walls. It is finding of this layer of fat in front of the tumor that has not already penetrated through the bladder wall that gives you the key as to how far you should proceed with your fulguration, or your cautery resection.

Dr. Budd C. Corbus, Chicago (closing): I claim nothing very original in the application of diathermy, except the matter of refinement of technic. Every one who had read the literature must give credit to Nagleschmidt, who first demonstrated the heating through of tissue. In Chicago in 1917, at the meeting of the American Urological Association, Dr. Kolischer demonstrated the method of diathermy. I am also familiar with the work of Dr. MacGowan. Unfortunately, I do not belong to the same "camp" as others in Chicago and do not use the same method. We do not wish the sparks to "rain down." When you rain down sparks you have an area of carbonization and your current will no longer travel toward the electrode but out to the border of the carbonized tissue. Our applicators are laid down tightly on the tumor; they are flat and the coagulation is obtained without any spark.

As to burning back the ureter, that idea was rather coincident. About four years ago we coagulated a tumor situated near the ostium and a short time later found the ostium burned away. Then, hearing Dr. Lower's paper, I concluded it would be possible to burn the ureter back. I tried it on dogs first and now have three clinical cases in which I have used this method.

In regard to closing the bladder, we have had some discussion as to whether it was advisable or not. It seems to me in the treatment of these tumors it is uncertain whether we have burned far enough or not, and I believe it is best to put in a Pezzer catheter. That put the tissue at rest and after a little while you can remove this and have access to the cancer just about the same as if it was on the cutaneous surface. If it is necessary then we can go in and treat the tumor with radium.

I do not offer this method as a panacea at all, but just an effort to treat the tumors of the bladder.

Dr. George C. Smith, Boston (closing): There is just one point in which all the speakers are agreed, and that is that the surface application of radium in the treatment of cancer of the bladder is not the method of choice. I believe if that method is used the mucosa may be destroyed and the surface will heal over, but it seems probable that there will be an active focus of cancer cells beneath the bladder mucosa. I think the idea of treatment expressed by all three readers is practically the same. The end sought has been the same—the active necrosis of the malignant cells throughout their extent. The only question seems to be which method will best answer the object sought. I can see certain advantages in the method of diathermy as described by Dr. Corbus; namely, the removal of most of the tissue at the time of operation without as much resulting sloughing as we get after radium. On the other hand, I do not know whether he knows exactly how deep the lethal effect of his active electrode extends; unless he carries that active electrode pretty well through the tissue he is not sure he is getting all of the growth. In using the radium we know that it will kill at about a centimeter from the tube and we can then pretty well include the whole growth within the sphere of activity.

As a point against his method of treatment, I would say that the time of operation would be a great deal longer in some cases in which the time of operation may be a great factor.

In regard to drainage of the bladder after treatment, it has seemed to me essential to institute this. A great many of the bladders are badly infected and I think they should be put at rest and cleared up by suprapubic drainage. I have felt that my period of drainage was too short rather than too long.

Dr. Leo Buerger, New York (Closing): I believe that Dr. Smith will agree with me that if we all had radium emanations at our disposal we would make every effort to understand the proper application of these emanations. Our results would be so gratifying that, after a short time, we would regard the diathermic method as being far inferior. I do not wish to be accepted as recording the idea that there is no field of usefulness for electro-coagulation and diathermy, but when we employ it, as has been pointed out, we do not know how much we are accomplishing. With radium we know that we have something that acts for days after its insertion, and something that can destroy cancer cells at a far greater distance than any form of electric heat that we can employ. If we employ electro-coagolation we certainly destroy the cancer cells up to a certain point; whereas, if we can employ the radium emanations we can get more extensive action. Diathermy is still to be regarded as experimental; with radium we get far better results. In my hands the radium method has a much greater field of usefulness and is a far more potent method.

As to removing small pieces of tissue for diagnosis, I cannot agree with those who believe that there is a great element of danger in this custom. On the contrary, I recommend it for the reason that we have to make an early diagnosis so as to get the proper viewpoint for treatment.

In a bladder carcinoma there is a constant circulation of cancer cells. In almost all of the cancers of the bladder, cells are being cast off, and the removal of a small piece followed by electrocoagulation I think can do no harm, and is the best method we have for diagnosis.

ELECTROTHERAPEUTICS IN PROSTATIC CONDITIONS[1]

HISTORICAL REVIEW AND CRITIQUE

VICTOR COX PEDERSEN
New York

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INTRODUCTION

The plan of this paper is to present four points in logical order. First, the basis of professional unanimity of treatment in terms of diagnostic standards recognized by modern urologists on the one hand, and on the other hand in terms of electric standards accepted by electrotherapeutists of today. Second, the epitomized statement of forms of current so standardized that the novice may with safety and sanity begin work in this field. This detail repeats the same element in my recent work in Urology in Men, Women and Children. Third, a historical and critical sketch and summary of each type of current through errors of the past to correctness of the present in selection of case and current, duration and frequency of treatment and physiotherapeutic alternates and the like. Fourth, indications for modern electrotherapy in nonoperative, inoperative, preoperative and postoperative prostatic and allied vesical conditions.

For the statements of the standard currents, I am indebted to members of the standing committees of the American Electrotherapeutic Association on the standardization of each modality and notably to Dr. E. C. Titus and Dr. Frederick DeKraft, who through long familiarity with works and reports of said committees have rendered me very valuable aid.

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[1] Read by title before the annual meeting of the American Urological Association, Atlantic City, April 25 to 28, 1922, and before the New York Electors Therapeutic Society, February 1, 1922.

Nonoperative electrotherapy of the prostate excludes caustic methods such as Newman's galvanocautery sound of the last generation, Bottini's prostatotomy with Chetwood's improvement thereof of the present generation and suprapublic galvanocautery prostatectomy and intravesical electroprostatotomy, because each is definitely an operative technique.

The first point of this paper is the basis of professional unanimity of treatment between urologists and electrotherapeutists. Real urological diagnosis is hardly twenty years old, hence scientific work is classed as old, if prior to 1900 and as modern if later than 1900. Transitional groups pass from one period to the other such as the work of Porosz. Urologists and electrotherapeutists of the past were highly defective in both diagnosis and pathology but the urologists have since 1900 placed their science on a firm foundation. No form of treatment can expect acceptation unless its underlying diagnosis pathology and pathogenesis meet the standard of the specialty directly involved in all organs of the system concerned. Thus electrotherapeutists must be guided by the proposition that prostatic diagnosis cannot be completed except through cystoscopy with rare exceptions. No electrotherapeutic writer emphasizes cystoscopic or other advanced diagnostics until about the year 1910. Conversely urologists must accept the proposition that electrotherapy suitably adapted to properly diagnosticated cases is efficient in the degrees described by conservative electrotherapeutists. There is no other way in which statistics will be respected by physicians in general. Pathology is based on the five-lobe structure of Lowsley including the subcervical tubules of Albarran. Data must show one lobe or several or all lobes involved and much more than mere rectal adenoma or connective tissue deposit, the one producing new acini with relative softness and the other fibrosis with pressure obliterating acini. Malignant neoplasm has characteristic lawless cellular increase followed by destructive ulceration from cellular pressure. All obstructive forms require operative intervention sooner or later determined by the circumstances of the case. The infections if follicular may be greatly benefited by electrotherapy but if parenchymatous (acute or chronic relapsing abscess), demand surgery. Obstruction evidenced by changes in urethral calibre, trabeculations of the bladder, infections of the gland, bladder or kidneys, partial or complete, relapsing or chronic retention of urine are all factors which should be determined cystoscopically and recorded in office records as to degree and favorable or unfavorable progress. Case reports based on anything but objective diagnosis and written records are valueless in private as in hospital practice.

Pathogenesis consists in changes in the gland, rectal, urethral and vesical, and their influence on the upper urinary organs. Rectal enlargement, not always greatest, is often the least productive of symptoms, except absorption from obstipation. Urethral deformity and obstruction are of greatest importance because of their pressure on the bladder, ureters and kidneys. Surgery is the sole relief in definite cases and most lesions are recognized and measured solely by instrumentation and cystoscopy. The vesical signs are due to central, unilateral, bilateral or general enlargement with changes following the obstruction. These are chiefly trabeculation, sacculation, muscular atrophy or hypertrophy and cystitis with ascending infection of the kidneys. Only the cystoscope will reveal their earliest possible stages, which mark the best period for operative intervention. Electrotherapeutic measures can not possibly give permanent benefit to patients showing such changes.

In general all prostatism must be recognized as to the fact and degree of congestion, inflammation, abscess, hypertrophy, neoplasm or calculus.

The aims of electrotherapy are profound circulatory effects of nutritional rather than destructive character, because in chronic inflammation the circulation is indolent and cell proliferation follows. Any factor reverting this condition to the normal is of advantage. Undoubtedly the half-hour sessions of properly selected electrical measures are difficult to improve. The measure of treatment is the primary and ultimate physical result rather than the mere meter reading, especially in such modalities as diathermy, although the meter is indispensable.

The duration and the frequency of treatments should secure progressive benefits and never overstimulation. Hence relatively mild currents applied for a half-hour are more beneficial than potent applications for a few minutes. The following are the general principles of selecting modalities. Acute and subacute infections, require the x-ray or the high vacuum glass electrode. If chronic infection is active the same modalities are employed until organisms are absent and then the static wave, diathermy, sinusoidalism and the high frequency current may be used according to the benefit in a given patient, because some patients give inexplicably good results to currents contrary to expectations. The standards of electrotherapy, now definitely established, should be followed otherwise confusing or unsatisfactory records will ensue. A very disappointing omission in the past is that of standard procedures and that of detailed description of new or special methods. Hence no one may accurately try the methods or judge the results.

The term "cure" should be used with great caution because in many prostatic conditions no result is possible except temporary subjective improvement. Disease processes can not be materially changed, hence anatomic cure is never seen, although the function of the urinary tract may be fully restored for long periods by even nonoperative measures. Many former authors use the term "cure" so loosely as to deserve its denial. After-treatment through electrical and physical alternates is of great importance in correcting or increasing primary results.

The modalities of electrotherapeutics, described as fully as limits permit in this paper are: Faradism, galvanism, sinusoidalism, ionization, static wave, high frequency and radiotherapy.

The conclusions from the past are regret that diagnostics and pathology have been so indifferently regarded by electrotherapeutists duly demonstrated by almost total absence of complete case reports. Conclusive case reports are almost unknown in this literature whereas overenthusiastic generalizations predominate. Good results must be accepted as potentially true because the average physician does not misrepresent results. But results were good only because with conservative electrotherapy harm could not follow as soon as caustic treatments had become obsolete.

The conclusions from the present are that improved apparatus, full diagnostic measures and better selection of cases foretell a greater respect for electrotherapy by the art and science of medicine as abundantly demonstrated by the physiotherapeutic divisions of the medical departments of all armies in the late war.

FARADISM

Modern standards should be compared with the lack of standard in former years. The high tension coil with windings giving current according to demand is the first essential. The outer, movable or secondary coil is always the source of current. Fine windings of wire giving anesthetic effect are no longer endorsed whereas coarse wire producing physical effects is the choice. The best coils are marked 1000, 2500, and 5000 (meaning the number of feet of wire used, according to the position of the switch). The preference for 1000 feet because of greater physical effect. A weighted vibrator timed to 30 oscillations per second, thus agreeing with the average normal muscle fibrillation, is a necessity. Interruptions of current may be made with the hand switch or the metronome, at a rate not to exceed the pulse rate thus permitting inflow and outflow of blood, stimulating evacuation of metabolic products and avoiding the exhaustion or the spasm of tonic contraction. Insulted electrodes with the terminal applied to the prostate and a large dampened pad to the pubic region are the best combinations, but intraurethral electrodes are not advisable. The strength of current has less respect for sensation than for muscular contraction, perceived by the patient without pain, discomfort, fear or weariness, beginning mildly and increasing in intensity. The duration of treatment is from fifteen to thirty minutes, the frequency alternate days, and the results muscular tonicity, profound circulatory effect and relief of circulatory glandular and tissue stasis and of muscular atony. The electrotherapeutic alternate is diathermy followed by static wave or the galvanic constant or interrupted sinusoidal current.

The physical adjuvants are hot and cold hydrotherapy as a circulatory decongestant or stimulant in chronic prostatitis or sedatives in acute prostatitis.

Tripier, the pioneer of medical electrotherapy, has a section on the prostate in his Manuel d'Electrotherapie, 1861, illustrated by a cut showing the electrodes in position and accompanied by a case history. He devised a urethral prostatic electrode and a rectal electrode, both metallic and insulated save at the area of application and termed "exciters." He therefore anticipated the developments of later years. The first current tested was from a galvanofaradic battery but was painful, hence he changed to a faradic current with rapid interruptions. His usual recommendation is to use the urethral and rectal electrodes in the same circuit, but if the former is not tolerated to introduce both exciters into the rectum.

The patient was forty-four years old and suffered from gonococcal gleet, enlargement of the right prostatic lobe, against which the rectal olive was applied. The treatment was long, 70 sessions of ten minutes each, and the gland underwent a reduction with disappearance of symptoms. Tripier admits that the case is not free from objection as the retention followed the use of Lallemande's porte caustique. Before this there had been no obstruction.

There seems to have been no further account of Tripier's activities in this field. There is no record showing that he measured the galvanic current in milliamperes or the faradic current in vibrations per second. His coil probably was of fine wire and redundant turns giving anesthetic more than physical effect. Hence no one may really judge the quality of his work.

Beard and Rockwell, the American pioneers, had one negative result in hypertrophy, also seen with Dr. Gouley. They used both the internal and external faradization but the former was badly borne and discontinued. The treatment aggravated the cystitis and had to be given up. Mittendorf informed the authors that he had obtained decisive benefit in two cases by external faradization alone—poles on symphysis and perineum.

Porosz (1895–1897) (called in the literature Popper) of Budapest originated systematic faradization. He had developed technique by 1897 when he read a paper at the Moscow International Congress and was apparently early in the field. In the first paper he mentions as an indication painless prostatitis with spermatorrhea. Instead of insulated metal rectal electrodes he used hard rubber electrodes with metal plates connected with the wire. The other pole was above the pubes. He begins with a weak current and increases slowly until contractions appear, then shuts off the current and repeats the sequence so that there is a contraction every two or three minutes. His principle object is to cure spermatorrhea. In the accompanying case the patient had hypertrophy. Incidentally he found the large prostate was reduced by faradism. This early communication was very brief. In 1903 his second paper was published (1). He had added a hard rubber urethral electrode to his armamentarium and in some cases used both together like Tripier. As late as 1910 this author was using faradism. He mentions others who have tested the method—Richter, Franck, Rothschild, Dommer, Scharf, Jauch, etc., but he gives and we find no references. The information may have been verbal. He still advocates voluntary interruption to produce 30 contractions in two minutes and daily sessions for four or five weeks. The indication is prostatitis associated with posterior urethritis and the method is put forward as superior to ordinary massage. There are no disagreeable features—although in one paper he states that in some patients the currents must remain weak.

In the period after Porosz's paper in 1897 the subject is discussed at the French Urological Congress in 1899. The statement is made that Ultzmann of Vienna recommended faradism but we can not verify it. Janet apparently tested Porosz's method using the finger electrode in the rectum. The statement that Hogge used faradism is an error. He used galvanism.

In 1901, probably earlier, King of New York announced in his textbook, that faradism was the current to use first. Galvanism is more risky. Either the bulbous rectal electrode or the spermatorrhea water electrode could be used, the other pole being applied at the perineum or hypogastrium. Faradism is well borne in active congestion. He states that the secondary coil should be wound with long, *fine* wire, which is directly contrary to modern standards. King is guided by the patients' sensations and contractions. Indications appear to be active congestion, atrophy of the prostate, and subjective and functional symptoms of hypertrophy. Sessions may be repeated often. King probably went over to high frequency at a later period.

In 1909 Courtade, writing on high frequency, mentions rectoprostatic faradization with Apostoli's carbon electrode as beneficial in chronic prostatitis. Massey alludes to a primary faradic current as an adjunct to other methods. Several recent systematic writers merely mention faradic current.

Muller, a disciple of Porosz (2), published his indications as subacute and chronic prostatitis and secondary atrophy. He places the odd pole over the sacrum instead of the symphysis, uses a metronome interrupter breaking the current 60 times a minute. One interruption lasting a quarter second. The strength should cause muscular contraction.

Castex (1916) mentions a rhythmic current with coarse wire coil (Porosz used the current from the secondary coil). After 1916 there is no longer any special literature on this modality.

Summary of faradization

Only one author developed technic of faradization with definite aim, which has been endorsed by a considerable number of practitioners: Porosz Mor, often spoken of as Popper, and once as Mor, of Budapest. He began his method in 1895, while testing a treatment for spermatorrhea and discovered the action of the current on the engorged prostate incidentally. In one article the author mentions that his current is derived from the secondary coil. The indications are the same for massage. His induced contractions of the musculature of the prostate disgorging blood, lymph, etc. In his last paper he showed that his faradic is superior to digital massage. There is practically no fully recorded case material. In 1910 he was still recommending it.

In modern urology the use of faradism is to stimulate the atonic bladder and its atonic sphincter in all such cases, especially in post-operative states. Mild currents continued for twenty to thirty minutes are the choice.

GALVANISM

Modern practice presents the following standards by which older authorities and their works suffer. Galvanism is a continuous positive or negative current whose polarity effects cause electrolytic or chemical change. The current is followed by nutritional or destructive changes depending on the strength of current and method of employment. Batteries maintained at high efficiency for the desired milliamperage are the preferred sources unless a generator is available, free from the fluctuations common to the street current. The rheostat reads 0 to 20 and the milliamperemeter ranges from 0 to 70. Insulated electrodes are always used and the negative pole (because relaxing) is in the rectum for acute conditions and the positive pole (because stimulating) is used for relaxed conditions, while a moist pad about 6 by 4 inches is on the pubic region under a sandbag. The strength of current is up to 10 milliamperes for acute and from 60 to 70 milliamperes for subacute or chronic conditions, always beginning low and ascending in intensity and producing sensations but no pain. The current should never be used without a meter. The duration of treatment is from fifteen to thirty minutes. Weak currents with maximum duration are far preferable to strong currents with minimum duration. The frequency of visits is alternate days and the results are determined by the positive or negative polarity, respectively acid and alkaline in reaction. The electrotherapeutic alternate is the Oudin current through the high vacuum glass electrode. The physical adjuvants are hot and cold hydrotherapy and phototherapy for circulatory stimulation or sedation on the following day as needed. Digital massage is not advisable.

The pioneers of galvanism of the prostate were clearly Cheron and Moreau-Wolff of Paris, who originally collaborated; later

Moreau-Wolff worked alone. The earlier cases were before 1870, when they detailed 10 cases. In 1876 Moreau-Wolff made a second report without detail, having treated many cases in the interim. A third man in the field was Mallez of Paris in 1875 who reported an inaccessible paper.

The technic was simple. A cylindrical copper exciter was introduced into the rectum. Its upper portion was insulated and its metal tip held against the prostate. The positive pole was a wet sponge against the perineum. The first electrode was urethral, but the result was not satisfactory. Each session, about ten minutes long, with current from as high as 20 elements, was repeated every second day. All prostatic lesions were treated—young men with prostatitis, and old men with hypertrophy. The ten reports are monotonous.

In 1876 Moreau-Wolff summed up six or seven years' experience. He had never failed to give relief, had improved many cases and cured some radically. The technique had never been modified. Simple congestion always yields to treatment, while acute and chronic prostatitis do better than under any other plan. In hypertrophy there is often functional improvement even in confirmed cases. Patients abandon the catheter after years of addiction, while in others the use of this instrument is facilitated.

The next reporter was Newman. His first paper, on electrolysis in surgery, appeared in 1885 and he refers to electrolysis of the prostate. Unable to devise a technique which could be depended on he used the platinum cautery loop although the caustic action was slight. His prostatic work was the outcome of urethral electrolysis in which he was a pioneer. Newman summed up prostatic electrolysis by the statement that he had benefited some, made others worse and had not influenced others. It must be remembered that he used only a urethral electrode.

Of two disciples, Bryce of Richmond, and Davis of Atlanta, the former reports a single old prostatic in 1887. He relieved him remarkably but after each session there was urethral fever. He used a urethral electrode only. Much more extensive was the experience of Davis. He treated 37 cases of which three are reported in detail. Apparently none of his men were prostatics, or at least all were postgonococcal lesions. In these 37 cases he used only a urethral electrode or at least nowhere mentions a rectal one. The work of Newman, Bryce and Davis differs radically from that of Cheron and Moreau-Wolff, who early discarded the urethral for the rectal electrode. This American method was therefore doomed to failure, because caustic in its primary results.

It is quite likely that Hutchinson of Providence, who published a volume on Medical Electricity in 1888, was an older pioneer than Newman. He moreover used a rectal electrode. In 1881 he was treating these patients by general galvanism through the trunk, with consecutive faradism. Later but before the publication of his book he was using a double urethrorectal current, the rectal electrode at the positive pole and held in place by the patient while the operator controlled the negative urethral electrode. He never goes beyond 2 milliamperes and the session is thirty minutes long. Apparently he aims at the relief of prostatism. The rectourethral sessions cannot be repeated over once a week, as the rectum may be perforated. Instead one may withdraw the urethral electrode and apply a wet sponge over the sacrum, reversing the poles. Treatment should be kept up a year. Hutchinson has been overlooked by all writers, for no one quotes him. He is entitled to credit for priority in rectal galvanism among English-speaking peoples.

Hutchinson was followed by an Englishman, Steavenson of London, who in 1890 published Electrolysis in Surgery, with a section on the prostate. He devised an ivory rectal electrode with metal inset connected with the negative pole. His aim was to relieve obstruction and he recommended weak currents—not over 5 milliamperes.

It is peculiar that Beard and Rockwell are silent on galvanism in all their editions.

The next in order is Betton Massey in 1893. Years after we find his statement that the case then reported was his only good result. He mentions an insulated rectal electrode and a large abdominal electrode of the type used by Apostoli for fibroids of the uterus. He recommends a high milliamperage, 60 not being excessive, and advises the addition of the primary or coarse secondary faradic current. This must have been a very old type of faradic coil, with two secondary coils, one of coarse wire and the other of fine wire, used many years ago. He seems to have had in mind the relief of spermatorrhea, impotence, etc. The prostatic lesion aimed at is therefore chronic prostatitis.

Several years now transpire without important report on galvanism.

In 1899 Hogge of Liège tabulates 92 personal cases. The interest in them is in novel technique. Hogge used a finger electrode with a platinum inset connected with a bunch of wires. As the metal was applied to the prostate Hogge kneaded the latter and thus combined galvanism with digital massage. The positive pole was applied to the perineum. He has also made some use of the urethral electrode as the positive pole. During the passage of the current Hogge repeatedly breaks the circuit to promote muscular contraction; makes the duration of sessions five or six minutes with 5 to 10 milliamperes of current.

The next step originated with Shoemaker who, in 1906 announced that for some years he had used with benefit a special electrode or electrolyzer for rectal application. He illustrates this but gives neither description nor technique. He quotes many case histories but only for diagnosis. Even under the histories he does not define his method. One gets the impression that he has covered these omissions in an earlier article, but none is to be found. Shoemaker states that the galvanic current from a small wet cell battery is his mainstay, and he is about the last one to develop a galvanic technique.

There are, however, several who use water electrodes and ionizing solutions who should receive a special notice.

Pitcher, in 1907, recognized the importance of the hard, fibrous prostate. He recommends galvanism with negative electrode in the rectum and positive plate over the bladder. He increases the current of tolerance for ten minutes, then slowly reduces to zero, gives patient a rest of five minutes then repeats. This treatment softens the gland and reduces its size. Then to this galvanic current he adds the static wave. As late as 1913 a Frenchman, LaFonde-Grellety, writes of simple galvanism but he is unsatisfactory.

Systematic writers, authors of textbooks and the numerous advocates of static and high frequency current give perfunctory account of galvanic currents, chiefly the rectal, as alternates of the preceding. Newer modalities have seemingly sidetracked galvanism but only temporarily.

In 1914 Coutrade of Paris published his work, Notions Practiques d'Electrotherapie Appliquée à Urologie. After recommending high frequency current for acute and chronic prostatitis he details for other cases electromassage similar to Hogge's method. The author devised an electrode which does not differ from the finger-cot electrode of Hogge. The foundation is a rubber finger-cot but the author uses two, one being placed on the index-finger and consisting of entire thin rubber, while the second slips over it and has a number of perforations. Before slipping on the outside cot a little platinum foil is placed in a thin envelope of absorbent cotton and applied to the fingertip. This foil is attached to a thin stem and this is in turn to the rheophore and the outer cot is now polled on over all. The cotton is opposite the perforations in the tip of the latter. The entire electrode is dipped into boric solution. Vaseline must never be used as a lubricant as it would as an insulator. Soap should be used. The current is faradic and the pole negative, the positive being placed over the abdomen. In place of the faradic the galvano-faradic or simple galvanic may be used. But if the galvanic is used the current should not be constant but undulated, going from 0 to a maximum of 8 to 10 milliamperes, returning from 10 to 0. Each wave should not last longer than a second. If the galvanofaradic current is used the galvanic intensity should not exceed 2 or 3 milliamperes. With the faradic or galvanofaradic currents one may use Apostoli's carbon electrode in the rectum while an olivery sound may be used for the urethral electrode, of copper or silver. These treatments give great relief in chronic prostatitis.

Summary of galvanism

There is a striking absence of standardization in the past. No summary is possible. Some currents were very strong, others very weak and the same disparity is seen in frequency and duration of treatment, electrodes, indications and results. No way is open to arrive at a consensus of opinion. Modern standards are however reliable and permanent.

Urology of today has these indications for interrupted galvanism in prostatics: First, the relief of congestive states in non-operative treatment or in-operative cases as an alternate or substitute for other modalities; second, restoration of post-operative atony or damage of the muscle wall and sphincter. These aims are identical with those of neurologists who successfully employ it in muscle lesions of neuritis, paralysis, and surgical injury.

SINUSOIDALISM

The sinusoidal current is a slowly rising and falling unidirectional continuous current reversing its polarity at the end of each cycle. It, therefore, alternates contraction and relaxation of both striped and instriped muscle. If the wave is timed to agree with the heart rate disturbance is avoided and benefit ensues in the muscle substance or organs like the prostate containing muscle. The source is faradic current from the type of coil already noted under "faradism" and galvanic current from the source described under "galvanism" each being used alone or both in combination according to needs. Therefore all details are the same as to rheostat, milliamperemeter, strength of both forms of current, electrodes and their placing. The sine wave agrees with the pulse or is directly proportional therewith, such as half-rate or quarter-rate. The sinusoidal controller reads from 0 to 10. The strength of current is that laid down for galvanism and faradism and determined by the muscular contractions and sensations and meter. The duration of treatment is from twenty to thirty minutes without weariness and the frequency alternate days. The effects of the faradism and galvanism are the same as those for each current separately except that the sine wave of the galvanic current affects the unstriped as well as the striped muscle, whereas faradism affects only the striped muscle. The physical adjuvants are hot and cold hydrotherapy and phototherapy exactly as just stated. Digital massage is not advised. Sinusoidalism was unknown to the older writers and its real development has been so modern that one can not revert to the past but for a very short period The galvanofaradic current is mentioned in the literature primarily by Tripier, the pioneer. He discarded it for the faradic. The only one to recommend the sinusoidal current seems to be Larat, the first edition of whose book appeared about 1900. This author uses the term "alternating current." The term sinusoidal has been added by commentators. In 1900 he had been using his alternating current for several years. He does not state how he obtained it. He used an intrarectal olivary electrode with the indifferent pole above the pubes. The current, at first imperceptible, is pushed to tolerance. In 1907 Massey speaks of the use of "swelling" currents by the recto-abdominal route as a remedy for prostatitis. Coutrade, 1914, speaks of galvanism as "undulating" from 0 to 8 or 10 milliamperes, each wave lasting a second. This closely simulates sinusoidal current.

Up-to-date urologists may use galvanic sinusoidal in the same cases as are noted under interrupted galvanism. The sinewave corresponds very well with the manual or metronomic interruptions spoken of under galvanism.

IONIZATION AND WATER ELECTRODES

Ionization and water electrodes belong under galvanism, because this modality is employed and is produced by the same source, rheostat and meter as given under that subject. The electrodes are urethral in type, insulated down to the last inch or so. The negative of copper or zinc is placed in the urethra while the positive pole, a large pad, is on the pubic region. The strength of current, always continuous never interrupted, should cause no muscular contraction but only mild warmth under a range of from 1 to 5 milliamperes. Treatments last from five to ten minutes, on alternate days and relieve subacute and chronic engorgement. The electrotherapeutic alternates are diathermy to increase the efficiency and the wave current to produce tissue contraction. Digital massage and hot or cold hydrotherapy are best omitted while phototherapy is almost equal to diathermy as an adjuvant.

The first account of cataphoresis, which precedes ionization and differs from it only in definition, is by Overall, a pioneer of medical electricity in the United States. The article appeared in 1899 in the thirty-second volume of the Journal of the American Medical Association. The author was seeking a rational treatment of spermatorrhea and impotence and with this aim attacked the inflamed prostate. His title is Electrolysis and Cataphoric Medication in the Treatment of Chronic Congestive Prostatitis and Its Sequels. Like nearly all writers in this field he leaves technique to the imagination of the reader. He speaks of urethra land rectal cataphoresis with eucalpytol and benzoinol, current strength 10 volts, duration three minutes. He is the first to use the street current with shunt. Overall seems to be the first to distinguish his prostatic cases into two broad classifications, the nongonococcal and the gonococcal, thus he conforms in part with modern urology.

King in his textbook on medical electricity, 1901, speaks of the "spermatorrhea water electrode" in which the current is given in prostatitis by electrification of the water. He says nothing as to the deviser of this apparatus and method. About this time Guiteras employed a water electrode in prostatitis. Like numerous colleagues he was testing Bottini's method, about this time. There is no contribution by Guiteras available.

In the discussion of Pitcher's paper in 1907, Betton Massey states that he tried cataphoresis but would now abstain from urethral electrodes in all circumstances. The same statement is made by the Jacobys in the last edition of their textbook. This statement may be true as to such methods but it is not true as to other methods of applying electricity through the urethra.

During recent years several men have been identified with ionization and water electrodes. Neiswanger in the United

States originally devised an ionization technique but seems to have abandoned it for hot electrified water. Kesteven in England, has developed a technique in which the solution used is 10 grains iodide of potassium in sterile water. He has also employed a special electrode. Neiswanger experimented with iodide of potassium and thiosinamine but seems to have gone over entirely to galvanism through a water electrode. Some of the more recent systematic writers give the technique of Neiswanger without comment.

Summary of ionization

Summary of ionization is, like that of galvanism in general, impossible for the causes therein stated. It is very probable that the wrong use of the positive pole in the urethra and its withdrawal without relieving adhesions to the metal tip by reversing the polarity, was the fundamental and final discouraging factor, which no longer exists.

In present urology very mild ionization is useful in boggy granulations and bullous edema of the prostatic urethra in lesions of the gland. The zinc urethral electrode on the negative pole is used for subacute conditions requiring relaxation and on the positive pole for chronic lesions requiring stimulation. Oxychlorid of zinc is deposited in the depths of tissues for nearly 0.5 cm. The strength of current should be 3 milliamperes and its duration five minutes. The polarity should be reversed if the positive pole has been used so that the relaxing effect of the negative pole will relieve the adhesion of the mucosa to the zinc and thus avoid even mild trauma of the surface. Ionization should be the last modality tried by the novice and not until he has mastered all others.

ELECTROLYTIC PROSTATIC PUNCTURE

Prostatic electrolytic puncture, now obsolete, was an outgrowth of electrolytic puncture of tumors. Biedert, of Hagenau, began the method about 1880 and published his first article in 1882. Casper, knowing nothing of Biedert's activities at the outset but learning of them in time to give him credit in his own paper, reported his cases in 1888. Roux a Swiss, whom we have not located, also reported the method at the same period. Biedert reported 5 cases, Casper 5 and Roux 6. When Biedert published his second paper in 1888 he reports no new cases. Casper does not even mention the method in his work on urology. As far as can be determined nothing has been published on the method since 1888.

Little space can be devoted to it but there are points of interest. It was intended to reduce hypertrophy because akin to neoplasm. Biedert reduced two prostates so that the catheter could be dispensed with. Two other large prostates were benefited. The fifth case was chronic prostatitis in a young man was also remedied.

Casper's patients were all elderly men with hypertrophy. He gives 4 detailed histories. Two men were notably benefited but one of the others developed a fistula.

Roux describes his 6 cases with brevity. One patient was yet under treatment, one did not come back after the first session and of the others all showed reduction in size and functional improvement. Pain seems to have been severe although the other operators did not seem to have this experience.

The method is not caustic in any sense. The only action is electrolytic. It is essential that the needle enter the prostate in a number of different localities so that the entire hypertrophic area is subjected to electrolysis.

The needle used was of platinum or platino-iridium or in Roux's work, of steel. One very large positive pole was placed over the abdomen.

Biedert mentions no amperage while Casper turned on from 10 to 25 milliamperes and Roux 70 milliamperes which probably caused so much pain. Biedert used from 12 to 18 battery elements. Casper did not go above 12 cells. The current was begun with 1 or 2 cells and slowly increased to the maximum used.

Turner (3) says of this method: "By this operation holes are bored into the hypertrophic tissue and their walls then cauterized and disintegrated. The result is to set up so many foci of necrosed matter, by means of which, through the ordinary process of absorption cicatrization and contraction, the gland becomes much reduced in size."

Summary

Small wonder a process so masked and unsurgical was doomed to rejection.

STATIC WAVE CURRENT

The static wave current has high voltage and initial low amperage with spark-discharge, giving pulsatory effects. It is a capacity discharge of a unidirectional current, whose high voltage and low amperage disperse rapid electrophysical effects in the part under treatment. Contractions according to physicists and physiologists occur in all contractile tissue and even in cell protoplasm. The source is a motor-driven, not hand-driven, multiple plate static machine of sufficient capacity, governed by a rheostat with many small step-ups and a milliamperemeter for vacuum tube and x-ray tube duty. The wave current is one of high voltage and fractional milliamperage. The electrode is of insulated metal tip prostatic type applied to the gland for the wave current or the high vacuum glass electrode for the actinic influence of the negative pole. The proper strength of current produces contractions tolerable to the patient, without painful sensations. The sparkings are 60 to 120 per minute. The frequency of treatment is alternate days given from twenty to thirty minutes and the immediate results are without discomfort to the patient. The electrotherapeutic alternates are the vacuum tube and diathermy and phototherapy—the last two being similar. Digital massage, hot and cold hydrotherapy are of doubtful value. In prostates whose acini fill up and discharge periodically, digital massage is a required adjuvant.

The Morton static wave current was introduced into prostatic treatment by Snow about 1897. Snow was associated with Morton and incidentally found in treating a pelvic neuritis that the symptoms of prostatitis were benefited. Snow published various articles and editions of textbooks and in 1912 sums up the results. He had then treated 210 cases of prostatitis and in all but a few had completely relieved the symptoms. The static wave current has a contractile action on the musculature and this sums up its activity—there are no electrolytic or electrothermic effects and it is easy to see that it could fulfil the indications for the faradic and interrupted galvanic currents and tend to relegate them to the background. The contractions are produced at the rate of 120 to 180 to the minute and the sessions should be twenty minutes long. In the acute case with sensitive prostate the spark gap must at first be short and be gradually lengthened. These cases yield at times in seven to ten days of daily sessions. In the chronic case there may be required two or three months of sessions on alternate days. Snow's cases seem to have been well controlled and he seems to have coöperated with Swinburne, who possibly used the urethroscope in diagnosis but there is no definite report by him confirming this possibility.

Snow (4) quotes Swinburne in a classification of cases suitable for static wave current. This must have been a personal communication because Swinburne never published any book or paper on electrotherapy of the prostate and does not mention it at length at all in any article available. Of course, he may have written but never published a study of electrotherapy of the prostate.

The principle of the treatment is absorption of inflammatory exudate in prostatitis and Snow nowhere speaks of treating hypertrophy. In 1903 Snow published the technique in Manual of Electrostatic Modes of Application, etc. He used both a urethral and rectal electrode, together or each singly. Some do better under one plan, some under another. He describes his special metal electrode which is in general use. The spark-gap should be slowly lengthened up to from 6 to 12 inches for the rectal electrode.

A large literature now accumulates on the static wave for prostatitis. According to Pitcher (1907) it is a specific for the large congested prostate. While he follows Snow, Pitcher uses a higher interruption—from 200 to 300 per minute, with the long, straight, metallic rectal positive electrode and the negative pole grounded. After treating hard fibrous prostates with galvanism as already shown he follows with the static wave current to reduce venastasis, sparkgap 3 inches and frequency alternate dates.

In 1909 Jackson commended the static wave current, apparently not for prostatitis but hypertrophy. Most of his patients were over sixty. He had but one failure since beginning the use of the current. He claims remarkable results, often in very few sessions, but some required about 5 and even 8.

By this time high frequency was coming to the front but the static wave retained its place. Dugan (1910) pronounced it the best for the congestive stage of hypertrophy: rectal metal electrode as positive pole with negative side grounded.

Yale of Philadelphia (1910) prefers the Snow treatment (wave) in acute prostatitis which is chiefly gonococcal and quotes Cannon of Baltimore who has a record of 97 cases of prostatitis of which all but 14 were gonococcic. These all did well under the static wave and metal electrode of Snow. Keck of San Francisco (1911) uses the Morton wave but like others of the period combines it with high frequency.

Humphris, author of a British textbook (1921), is a partisan of Snow's wave current which he has used since 1902 when Snow instructed him. According to Humphris this method has undergone practically no alteration in technique. Hardly any one in Europe has used the Morton wave although the so-called Hertzian franklinization is evidently the same. Castex in his textbook on medical electricity (1916) recommends this in acute and chronic prostatitis as an alternative of high frequency the external armature of one condenser is connected with an intrarectal electrode—an insulated metal one. The other armature of the condenser is grounded. Three weekly sessions of five to ten minutes are recommended. The condensers in the circuit produce the static induced current, totally different from the wave current; hence Castex is an authority misguided as to the exact nature of the modality used.

Cumberbatch (1920) recommends the static wave in enlargement due to congestion only.

Grover in his textbook just issued states that he has treated over 800 cases of diseased prostate with the static wave with 60 per cent favorable results. The current is our best resource for sterilizing the prostate and vesicles of the gonococcus. He differs from most writers by stating that the patient should be insulated. He used Rice's L-shaped copper electrode instead of Snow's, connecting it with the positive prime conductor of the static machine, the negative being grounded. He limits the wave current to subacute and chronic cases, preferring high frequency in the acute form.

Summary of static wave current

Summary of static wave current shows that the wave current has made good over about twenty-four years. The indications are not wholly standardized and authors differ somewhat in distinguishing between the static wave, static induced and high frequency current. No good classification of cases, reports of cases and cystoscopic diagnosis before treatment or after treatment are given. Hence a very valid element in the diagnosis is omitted and much of the work is open to question and even rejection. In the matter of classification at least infected and uninfected cases should be recognized.

HIGH FREQUENCY CURRENTS

High frequency and alternating current are synonymous terms, applied to rapidly oscillating current converted into heat by resistance overcome and molecular activity excited in living tissue. Local and general diathermy are only manifestations, hence a definite quantity of heat may be applied to and developed in a part during heat such as a prostate. The heating is vascular, nutritional and relaxing in its primary effects.

The source is a standard transformer delivering high frequency current energized by a motor generator of not less than 2 kilowatts capacity. The usual portable apparatus sold in drug stores is worse than useless because it deceives the public and the profession alike. The rheostat must be the multiple-step, spark-gap type and the switch must have at least five steps—each device regulating respectively the voltage and amperage. The meter reads 0 to 2500 and is of the hot wire type. The electrodes are of the high vacuum glass type if the

Oudin current is used for rectal or urethral prostatic application; or the insulated metal tip rectal electrode with a large metal pad on the pubes if diathermic current be employed. The current, always continuous should produce no contractions but only a mild warmth while the milliampermeter registers from 200 to 1000 milliamperes within tolerance. Treatments persist from ten to twenty minutes, on alternate days and decongest the gland remarkably.

The electrotherapeutic alternates are static wave and static vacuum tube and phototherapy. Digital massage and hot or cold hydrotherapy are best omitted.

High frequency currents in prostatic disease are not readily traced. King does not mention this modality in his textbook of 1901, and in Snow's volume on static electricity in 1903 there is no mention. Doumer used high frequency as early as 1900 and Weil reported a case in which Doumer's technique was used in 1902. High frequency in France was synonymous with Doumer. Up to 1906 he had treated and reported 122 cases of prostatic disease of all kinds. He used both the Oudin resonator and the d'Arsonval solenoid. These currents have he says no different action from the Morton wave current.

This is a scientific error because the static wave current is a unidirectional capacity discharge current and not a high frequency oscillatory current in any sense whatever.

Doumer is an exception to the rule that French authors do not use the expression "static wave." They have the so-called "Hertzian franklinization" or Bordier circuit, which is supposed to be the same in as far as condensers are used with the circuit. The current itself is not the same as the static wave current because the condensers produce the static induced current which is unidirectional capacity discharge, usually too powerful. This passage is the only one among French writers which speaks of the "Morton wave," although they often speak of "Hertzian franklinization." Here again is an author who in good faith but in ignorance of electrophysics confuses four modalities, Oudin, D'Arsonal, static wave and static induced currents. Their electrophysics and bodily effects are much different and not identical as Doumer says; hence his work must be discounted on modern standards but not totally discredited.

Of Doumer's 122 cases, 42 were simple engorgement, 63 subacute or chronic prostatitis, 2 acute prostatitis, etc. The great majority of results were fortunate as disagreeable symptoms are removed. The swelling diminishes by the third or fourth session, and after the seventeenth or eighteenth the gland should be normal. In simple engorgement 6 or 7 sessions may answer.

Pollet (1906) gives a summary of Doumer's work. He began in 1900 with high frequency current in gonorrhea and its complications and tested it for prostatitis during the treatment for hemorrhoids. He devised special prostatic electrodes. The spark gap was 20 cm. He used two electrodes, one of bare metal and the other he improvised by placing a metal rod in a glass test tube. The sessions should be repeated daily, five or ten minutes, with metal and three to five with glass. Doumer's technique is given in great detail.

Pollet took his current from the resonator, which marks his modality as the Oudin unipolar current. Other authors speak of taking the current from the "top of the resonator," and therefore used the Oudin current.

In the United States King was using high frequency by or before 1905 when his book appeared. He drew it from the static machine and a resonator, and was using the glass vacuum rectal electrode. He has little to say about it in prostatic disease.

Titus (5) played the chief rôle in developing the subject in the United States. This author for several years had found the method of Snow efficient in simple prostatitis and vesiculitis, but not in gonococcal prostatitis and vesiculitis. For deeper contractile action and noncorrosive chemical action he devised the rectal insulated vacuum electrode which goes by his name. This proved curative in gonococcal cases, energized from the negative side of the static machine with the positive side grounded.

In 1908 Johnson of Hartford gives one of the earliest systematic accounts. He used Titus's insulated vacuum rectal electrode with patient on the insulated platform. This electrode is connected by the rheophore with the negative side of the static machine. He began with the short spark gap. The spark gap is opened 1 inch. Johnson has treated both prostatitis and hypertrophy and claims excellent functional results.

The output of the standard static machine according to Harris and Riess is given under x-ray treatment hereinafter, but Johnson makes the following erroneous statements: The high speed static machine gives at most 120,000 volts with amperage but 0.55 milliamperes. The optimum rate of interruption is 1500 per minute, obtained by means of the condensers and resonator. Other data mentioned are 910 revolutions a minute, and two 32-inch rotating plates. When condensers and surge resonator are thrown into the circuit, the 1⅓-inch discharge balls are drawn apart 1 inch. When the pulsameter shows 1500 interruptions a minute, he found this rate to be the optimum. The usual static machine delivers about 11,000 volts for each inch of spark-gap and from 0.5 to 2 milliamperes but the studies of Harris and Riess are more accurate and give much higher voltage. Johnson's machine was much too small and his use of condensers in the circuit converted the current into the static induced current. In this degree his work was not with the static current.

Bolton, an Englishman, was using high frequency as early as 1907 when he reported some cases. In 1910 he sums up. He claims only relief of prostatic symptoms, not results of obstruction in order to be conservative. His current is harmless and painless, and is taken from the top of the resonator, the operator pressing his hand over the pubes. In urgent cases there should be daily sessions of fifteen minutes. In congestive and irritable cases which require soothing measures he prefers the metal rectal electrode while in the large hard prostate he uses a vacuum electrode or a condenser electrode. The symptoms benefitted are congestion, nervous irritability and irritable bladder. Reduction in size corresponds to the removal of congestion.

Walton of Richmond (1910) advocates the wave current and employs the Oudin frequency with glass vacuum electrode, especially in gonorrheal prostatitis; taking the opinion of Titus that this current is germicidal in prostatitis. Yale at the same period preferred the Titus high frequency technique for chronic prostatitis over the wave current. According to Yale the Titus electrode generates ozone and actinic rays.

Keck (1911) uses a resonator current from the static machine for the hard prostate, interrupting the current. In the soft hypertrophic prostate he uses a high frequency from the Ruhm korff coil figures, with copper electrodes. There is a diathermic action, as the feeling of warmth is the guide to shutting off the current. He alternates this treatment with the Morton wave. His technique is obscurely described.

Bishop of Washington (1912) describes an apparatus with two spark gaps, in which he gives a bipolar d'Arsonval current.

Jones of London in his textbook states that high frequency currents with rectal electrodes relieve the congestion and the symptoms of hypertrophy. Weil in his textbook (1916) states that high frequency by Doumer's method is of value in acute and chronic prostatitis and the early stages of hypertrophy. Grover gives but little space to it, and this could be placed under diathermy.

Courtade (6) in 212 pages devotes 10 to the prostate. The space is in part taken up with an account of prostatitis and hypertrophy.

The treatment of acute prostatitis is high frequency developed by Doumer—the earlier the better in order to prevent abscess. High frequency is antiphlogistic, calms pain and relieves congestion. He uses a naked electrode introduced 5 to 6 cm. into the rectum. The shape may be cylindrical or conical. Instead of this he uses an Oudin condensing electrode. There is little or no fear of electrocoagulation if the electrode is 2 cm. in diameter. The current should produce the feeling of heat. Doumer uses a Rocheford coil, an oil condenser and an exposed spark gap which give to the Oudin resonator its maximum intensity. The seance should last five to ten minutes. In order for the current to traverse the prostate the lower pole of the resonator should be placed in communication with a plate over the abdomen.

The same treatment may be applied in the chronic prostatitis, especially in neurasthenic subjects or in others who complain of pain which usually suggests complications. Results in hypertrophy are not encouraging. One may try the faradic with fine wire rapidly intermitted, with one pole in the rectum and the other in the prostatic urethra, or electromassage as already described, or ionization, in which a fenestrated urethral electrode is employed. Sodium solution 7 per 1000 is used here. Instead a zinc olive may be used with negative pole and not over 3 milliamperes for eight to ten minutes. In hypertrophy we can also aim at congestion exacerbations, using high frequency as already described and by applying efflues to the perineum.

Finally under diathermy—eliminating all caustic effects—there is only Grover to quote. If the glass vacuum electrode is used in the rectum, with the other connection over·the pubes, a circuit is set in action which rapidly heats the prostate and must be withdrawn at the end of seven minutes, else it will burn the tissues. The use of a metal rectal electrode and an abdominal metal plate as the poles is omitted yet this is the best method of focalizing this treatment.

Summary of high frequency current

The literature is unsatisfactory for several reasons. First when this current was introduced and for a long time after—in fact practically to date—the currents described were obtained from the static machine exclusively. This method of producing high frequency current has become obsolete. Every one now uses the street circuit and obtains high frequency from coils or transformers. Second, the reporters on high frequency had elementary knowledge of electrophysics and of oscillations which they never mention. Some of their currents could not have represented very high oscillatory frequency.

As yet I have found no mention of combination transformers in which the modalities could be varied at a single session.

The indications of local diathermy in modern urology are to induce healthful congestion and add to nutrition of the prostate in any lesion in which any other electrotherapy is advisable. If diathermy is used first and followed at the same session by the selected other modality the influence of the latter will be augmented. Medical diathermy or autocondensation is very valuable in absorptive and atonic conditions associated with the prostatic lesions.

Titus has shown that diaphoresis, diuresis with great increase in the total solids and remarkable exhalation of carbon dioxid by the lungs occur. In fact all elimination is increased.

X-RAY

The x-ray current is stimulating or inhibiting according to dose. The stimulating dose is followed by hyperæmia and increased cell action while the inhibiting dose produces tissue contraction and decrease of cell growth. These are the bases of action in prostatic cases. Hemorrhage may be controlled with the x-ray. The source of x-ray may be the static machine or the transformer. The static machine has the advantage of delivering about 127,800 volts when the standard ball terminals (0.866 inch in diameter) are 15 cm. apart according to Harris and Riess, both noted and independent investigators. Such voltage gives greater penetration than that from a transformer having greater amperage but lower voltage. Hence it is probable that x-ray treatment with the static machine for thirty minutes at 2 to 2.5 milliamperes thus delivering seventy to seventy-five milliampere minutes is more serviceable than treatment by a transformer delivering 10 milliamperes for two to two and one-half minutes, in total 20 to 25 milliampere minutes under considerably lower voltage and lower penetration but higher burning powers. This comparison is probable but is still under study. The x-ray tube should have a vacuum to back up a 5-inch spark gap between the ball terminals. This gap is equal to a 10-inch distance between the pointed terminals of the transformer machines. It is said that a transformer with standard ball terminals will deliver about the same voltage but the amperage is so much higher that it is almost sure to burn the patient whereas burns with the static machine are rare, in contrast with remarkable results.

RADIOTHERAPY

Fleig (7) dates the application of the x-ray to the enlarged prostate from 1905 when Balzer and Tansard treated cases in the Hôpital St. Louis. The results were published in 1906. Since 1905 the treatment of such cases has continued at the same hospital. The author mentions earlier cases: In the United States, Roberts in 1902, Williams in 1905, in Italy, Carabelli and Luraschi and in Vienna Moscovics also reported cases in 1905 so that Balzer and Tansard can claim priority only for France.

The authors have treated 70 cases. All save 5 of them were before the war. The majority have dropped out of sight but the authors controlled 13 whom they can test for end results. The technic consisting of perineal raying, is given in great detail and is omitted for brevity in the present connection.

In most cases the first symptom to improve is nycturia; and in 4 or 5 sessions the patient, rising 6 or 7 times a night, can get along with 3 or 4 urinations while the residual urine is cut down one-half. The gland may be smaller after the fifth or sixth session and the hard prostate decreases more rapidly than the soft. If but one lobe is involved the improvement at this period may be 50 per cent. In about 1 case in 6 this early improvement is not seen—that is, there is no reduction although there is subjective improvement. In the prostatic neurasthenic alone is there complaint of sensations after reduction of the gland. Fortunately these cases are rare. As a rule the patient has obtained so much benefit after 12 or 14 sessions that he disappears from view. A few of these patients are now under control and these have shown no recurrence after many years.

After 14 or 15 sessions the author voluntarily desists from treatment but keeps the subject under observation for several months. To go ahead indefinitely with treatment is without special advantage while there is danger of setting up dermatitis on the perineum. The author would limit the indication strictly to median hypertrophy at any stage save when the enlargement has become obstructive. The urinary functions should not be too much compromised and the general condition should be intact. The surgeon would not feel it necessary to operate on such cases so that the method does not compete with prostatectomy. The author fails to state the degree of hypertrophy by the usual comparison with familiar objects and he does not allude to the fact that there may be much obstruction with a relatively small prostate. His work would be far more valuable if cystoscopic findings were given as bases for proper selection of cases and as proofs of conditions before and after treatment.

Perrin and Wullyamez (8) reported the use of x-ray on all their prostatics. They take a midpoint between cure-all and cure-nothing. They are among the few electrotherapeutists who classify properly and diagnosticate with the cystoscope fully. The division of their material is: (*a*) prehypertrophic or congestive period; (*b*) hypertrophic or congestive period; (*c*) hypertrophy complicated with prostatitis; (*d*) hypertrophy with residual urine; (*e*) retention with tolerance; (*f*) retention with intolerance. The first, (the prehypertrophic or congested period) alone appeals to these authors. It is characterized by nocturnal frequency, morning priapism and absence of residual urine. The bladder mucosa is normal to the cystoscope. These patients are solaced by 3 or 4 applications of the x-ray, by diminution of nycturia and of sense of heaviness and discomfort. The rays are antiphlogistic and decongestant. Cases in the third category (hypertrophy with residual urine) after the appearance of the residual urine are benefited but without much reduction in the residual urine, in degree or constancy. Again the influence is decongestion. It may be assumed that the glandular tissue contracts while the thickened fibrous frame work is not changed, hence there is little reduction in the adenoma either to rectal touch or cystoscope. The best results were obtained from perineal raying, so that no rectal irradiation has been used for two years. The dosage is 3 or 4 Holzneck units, filtration 0.5 to 2 mm. of aluminum. The tubes were hard and marked 6 to 8 with Benoist's radiochronometer. The number of sessions was from 5 to 15, 3 to the week. The authors do not compare radiotherapy with other methods and are probably only radiographers. They do not mention the use of light for the purpose of avoiding x-ray burns.

CONCLUSIONS

Case reports could not be added to this paper, because the duration of time and the number of workers covered by this review resulted in a contribution far longer than was anticipated. Case reports will follow as soon as possible in the future after careful study and classification.

It is unfortunate that a method as important as electrotheropeutics should have been more or less disqualified by imperfect apparatus and improper applications and careless selection of cases in the past. Now that the types of appliance are well determined, it seems that makers are producing machines, too small for reliability or efficiency and selling them in drug stores for self-treatment, much like patent medicines. This wave of recoil will have to spend itself also. It is unfortunate that its undertow sets against real progress.

In another article I have said:

> If all branches of medical practice are to progress coördinately, they must do so through consensus of diagnostic standards. If diagnoses are not correctly made all treatment and its results will be open to grave question, or doubt, or even rejection. The second aim is that of convincing the urologist that electrical methods properly selected will convert the average operation into the method, not of primary but of secondary importance and not of first but of last resort. If progress in medicine is to be uniform, methods of treatment recommended by one specialty must be carried out strictly in accordance with directions, otherwise one group of observers will succeed and the other group will fail in exactly similar cases of pathological processes.

In this historical and critical review there have also been two purposes. There is in literature no single article which has attempted to bring into comparison the varieties of electrical treatment from their earliest development; or has endeavored to show the evolution of apparatus. In the past there has been no effort to make case reports the basis of conclusions and progress. It is relatively lately that case reports have begun to appear. This error on the part of electrotheropeutists is so readily corrected that it should not occur hereafter.

Those who do not as yet know the benefits of electrical measures should accept with open minds, good wherever found. Doubt should give place to real investigation and observation, as I have elsewhere said:

> There are a few basic principles which are altogether too often neglected. The patient must not be hurt or frightened; electrotherapy must be employed to augment all other measures and not necessarily to supplant any; the current must produce profound circulatory effect of creative character and it must be opposed to the circulatory condition of indolent character due to the disease; the modalities must be varied influences and finally the electrotherapeutic measures must leave no evil after-effects. If these simple principles are obeyed little trouble will be encountered.

REFERENCES

(1) Porosz: Monats. f. prakt. Darm., xxxvi, 79.
(2) Porosz: Zeitsch. f. Urol., 1910, iv.
(3) Turner: Manual of Practical Medical Electrotherapy, iv ed., 239.
(4) Snow: Urol. et Cut. Revue, 1913, xvii, no. 6.
(5) Titus: Med. Rec., July 25, 1908.
(6) Courtade: Notions Pratiques d'Electrotherapie Appliques a Urologie, Paris, 1914.
(7) Fleig: Le Monde Medical, Paris, September 1–15, 1921.
(8) Perrin and Wullyamez: Third Congress of Physiotherapy, Section on Radiotherapy, Lausanne, Switzerland, 1911.

REPORT OF A CASE OF STONE IN THE BLADDER WHICH FORMED AROUND SUTURE OF PAGENSTACHER LINEN[1]

HERMAN L. KRETSCHMER

Chicago

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The formation of urinary calculi around suture material in the bladder was formerly met with quite frequently after gynecological operations in which large quantities of silk were used. Since silk has been replaced by catgut, this type of bladder stone has become more or less of a clinical rarity.

Having recently had a case of this type under observation, I wish to briefly give the essential factors in the case. In this case I had an opportunity of cystoscoping the patient before the stone formed and before the ligature had wandered into the bladder.

Mrs. Z. Aged thirty-three. Patient was admitted to the hospital and a diagnosis of chronic pyelitis was made. One year previously a left salpingectomy, appendectomy and right ovariectomy was performed; also a ventral fixation of the uterus.

First cystoscopy, August 11, 1921. An area of ulceration was seen in the apex of the bladder and two smaller areas of ulceration were seen in the anterior wall. Otherwise cystoscopy was negative. Ureteral catheterization showed the presence of pus and colon bacilli in each kidney.

Second cystoscopy, September 22, 1921. In the apex of the bladder was seen a grayish white mass with an irregularly rough surface, about the size of a large bean. Upon closer cystoscopic examination, a very free end of a suture or ligature was seen, whereupon a diagnosis was made of a stone forming around a ligature that had wandered into the bladder.

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[1] Read before the Chicago Urological Society, October 13, 1921.

Third cystoscopy, September 23, 1921. Findings unchanged. The stone was removed with cystoscopic bladder forceps described some years ago[2] (fig. 1).

After removal of the stone patient was immediately relieved of her symptoms.

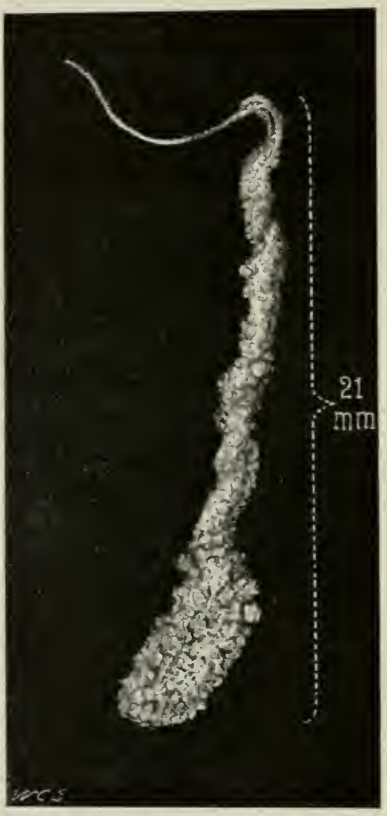

Fig. 1. Showing Free End of Pagenstacher Linen with Encrustations

It was just for this type of case that the modification of Young's rongeur forceps was deemed advisable since the forceps are grasping and not cutting and hence they cannot be injured as are the ordinary rongeur forceps when they are used for grasping stones, foreign bodies, etc.

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[2] Jour. Amer. Med. Assn., May 2, 1914.

PARTIAL SPONTANEOUS INVERSION OF A DIVERTICULUM OF THE BLADDER WITH DUMB-BELL STONE

CHARLES R. B. CROMPTON

The Mayo Foundation, Rochester, Minnesota

The extreme rarity of partial spontaneous inversion of a diverticulum of the bladder and also the coincident occurrence of a dumb-bell stone, presenting a clinical picture simulating carcinoma of the bladder with stone, rendering the differential diagnosis difficult, warrants this report. A search of the literature failed to reveal a report of a similar case.

REPORT OF CASE

Case A389878, Mr. J. K., aged sixty-two years, came to the Mayo Clinic April 25, 1922. In 1900, he was thrown from a wagon, and sustained a blow in the occipital region which rendered him unconscious for ten hours. Following this his home doctor repeatedly found sugar in his urine for a period of one year. At times the sugar had reached as high as 6 per cent, but on careful dieting it had disappeared. For the past fifteen years the patient had had moderate frequency of urination. The first of four attacks of left renal colic occured five years before, and on each occasion he had voided multiple stones. The onset was sudden, with typical radiation of excruciating pain from the left renal area posteriorly to the groin and penis. One year before he noticed burning in the urethra while voiding. This persisted for seven months when he noticed considerable difficulty. At times, the stream would be suddenly shut off, and dribbling would continue until completion of the act. At other times the stream was normal in size. He complained of a dull, constant pain at the peno-scrotal angle and in the perineal region. This was much exaggerated during and after voiding, and especially by sudden jarring while motoring or driving. During the last five months his frequency became more marked (every two hours day and night) and he always had a sense of incomplete micturition.

Physical examination revealed a healthy appearing, obese man, weighing 231 pounds, which was slightly less than his usual weight. The pulse rate was 82, temperature 98.6, respiration 18, blood pressure 196 systolic, and 126 diastolic. The teeth contained many fillings, and marked periapical granulomas were apparent in the roentgenograms. The tonsils were soft, spongy, and of the deeply crypted type with marked infection. Both fundi showed marked retinal arteriosclerosis consecutive to hypertension. Examination of the chest and abdomen was negative. Rectal examination revealed the prostate to be firm but not enlarged. The vesicles were not palpable. The external genitalia were normal. On two successive days twelve-hour specimens of urine amounted to 300 and 500 cc., with a specific gravity of 1.028 and 1.026 respectively. Both specimens were acid in reaction; there was a slight trace of sugar and moderate albumin on both heat and acetic acid and sulpho-salicylic tests; the low power of the microscope revealed a moderate number of erythrocytes and many pus cells. Examination of the blood showed hemoglobin 70 per cent, erythrocytes 4,500,000, and leukocytes 5,800. The Wassermann test on the blood was negative. Blood urea was 40 mgm. and urea nitrogen 18.6 mgm. for each 100 cc. of blood. The sugar concentration of the blood was 0.16 per cent. The combined intramuscular phenolsulphonephthalein test showed 30 per cent return, and a combined intravenous test 35 per cent return in two hours and fifteen minutes. A roentgenogram of the kidney, ureter and bladder showed a shadow over the left bladder area; it was dumb-bell in shape, lay transversely across the pelvis, each extremity of the shadow measured about 2 cm. in diameter; the mesial portion was much more distinct than the lateral (fig. 1). Cystoscopic examination revealed marked chronic diffuse cystitis with purulent urine in the bladder. In the left base of the bladder was a white stone about 2 cm. in diameter, apparently fixed to a tumor mass which elevated it from the bladder wall. The tumor had the apearance of a malignant papilloma of the solid type, and was about 3 by 4 cm. An attempt to dislodge the stone from the tumor with the beak of the cystoscope was unsuccessful. A specimen of the tumor obtained with the specimen-taker was found on pathological examination to be "inflammatory tissue." The ureteral orifices were not seen owing to the extreme degree of cystitis and to purulent bladder urine. On cystoscopy three days later litholapaxy was performed. At this time the tumor mass appeared clinically so malignant that the fragments of stone were not removed from the bladder, since resection of the tumor was thought advisable. A second specimen from the tumor was then obtained through the cystoscope with a specimen-taker. On microscopic examination this also proved to be inflammatory tissue.

Three days following the last cystoscopy a suprapubic midline incision was made and the bladder explored under ether anesthesia. The fragments of the bladder portion of the stone, crushed at litholapaxy, were found lying loose in the bladder. The tumor mass at the left base proved to be a small diverticulum almost completely inverted into the bladder cavity, and covered with extensive hypertrophic granulation tissue. A nodular, pyramidal shaped stone about 2.5 by 2.5 by 2 cm. was found lodged firmly in a sacculation at the apex of the inverted diverticulum. Several small stones were also found impacted between what had been

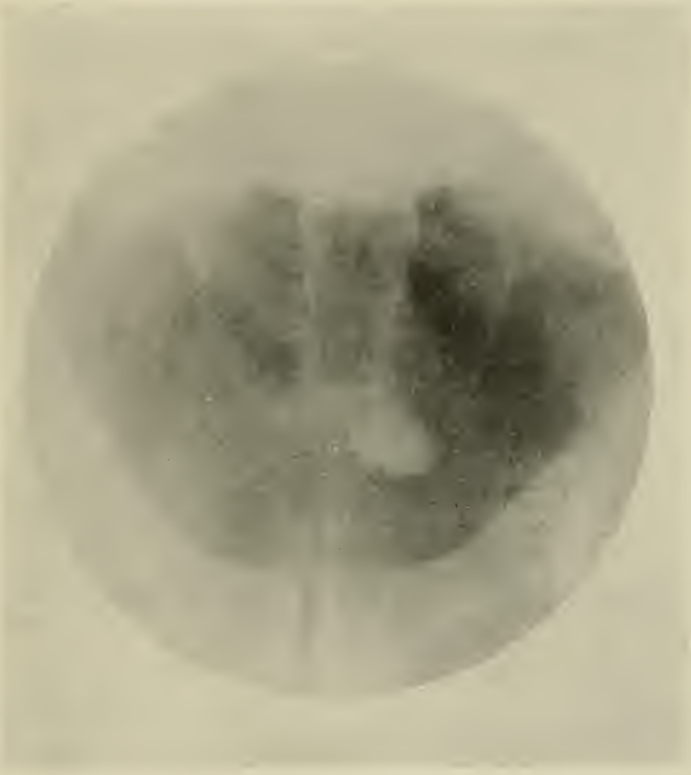

Fig. 1. Roentgenogram of Bladder Area Showing Dumb-bell Stone
Bladder portion distinct, diverticular portion just discernible

the orifice of the diverticulum and its inverted wall. The inverted diverticulum, which proved to be about 3 cm. in diameter and the same length, was dissected from the bladder wall with scissors, but on account of its friability could not be preserved intact. The cut edges of the neck of the sac were then cauterized with the actual cautery. Marked chronic cystitis was present. No intravesical enlargement of the prostate could be demonstrated. A no. 30 French rubber catheter was placed in the bladder and a split tube was inserted in the space of Retzius as drains.

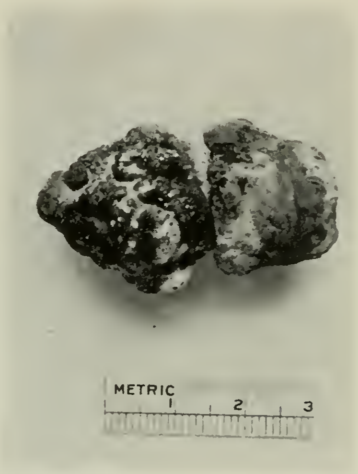

Fig. 2. Postoperative Specimen of Stone with Fragments Fitted in Their Original Positions

The bladder was closed with a double row of no. 2 plain catgut, muscles and fascia with no. 2 chromic catgut, and subcutaneous tissue and skin with interrupted silkworm-gut sutures. The pathologic report of the tumor mass was again "inflammatory tissue" with an ulcer about 2.5 by 2 cm. which had, apparently, contained the diverticular portion of the stone. On the bladder surface of the diverticular stone was an area of recent fracture from which the bladder portion of the stone had been broken off at litholapaxy; this showed it to be a dumb-bell stone (fig. 2).

DISCUSSION

This rare and interesting case was observed after twenty-eight cases of coincident bladder stone and diverticulum were reported from this Clinic. Five other cases of dumb-bell stone of the bladder are on record in the literature; one was reported by Young, one by Davis, one by Martin, and two by Crenshaw and Crompton. Including the case reported herein, four have occurred at the Mayo Clinic.

The history of repeated renal colics with the passage of stones points to the kidney as the source of the stones in this case. Possibly the stones passed into the bladder, were forced into the diverticulum, and produced the marked secondary inflammatory changes in the sac. A diverticular stone may have gradually grown and protruded into the bladder, acting as a nucleus for the formation of the bladder portion of a dumb-bell stone. It is difficult to determine how almost complete inversion of the diverticulum into the bladder occurred. Possibly in an endeavor on the part of the bladder to expel the bladder portion of the dumb-bell stone, the sac was inverted, impacting the smaller diverticular stones in its edge. Another factor in the production of bladder and diverticular stones is the etiologic relationship between stone formation and diverticulum of the bladder. This case also demonstrates that occasionally a benign tumor of the bladder, or an inverted diverticulum, may appear, clinically, very malignant. This emphasizes the necessity for microscopic examination so that the degree of malignancy may be estimated in all cases of bladder tumor. Broders has pointed out that the degree of malignancy materially alters the mode of treatment and ultimate prognosis of the case.

REFERENCES

(1) Broders, A. C.: Epithelioma of the genito-urinary organs. Ann. Surg., 1922, lxxv, 574–595.

(2) Crenshaw, J. L. and Crompton, C. R. B.: Coincident calculus and diverticulum of the bladder. Collected Papers of the Mayo Clinic, 1921, xiii, 358–367.

(3) Davis, E. G.: Recurrent vesical calculi associated with calculus in diverticulum and contracture of the vesical neck. Surg., Gynec. and Obst., 1920, xxx, 503–505.

(4) Martin, S. P.: Dumb-bell stone in diverticulum of the urinary bladder. Ann. Surg., 1918, lxvii, 94–95.

(5) Young, H. H.: Treatment of vesical and diverticular calculi. Tr. South. Surg. and Gynec. Assn., 1911, xxiv, 382–408.

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RENAL COUNTERBALANCE[1]

AN EXPERIMENTAL AND CLINICAL STUDY WITH REFERENCE TO THE SIGNIFICANCE OF DISUSE ATROPHY

FRANK HINMAN

From the Urological Department of the University of California Medical School and Hooper Foundation for Medical Research, San Francisco

I. INTRODUCTION

Modern writers accept too readily the occurrence of compensatory hypertrophy of the kidney. Evidently its observation has been so long general as no longer to attract notice or comment. At any rate its true significance and importance, particularly in relation to the surgery of the kidney, has been almost entirely overlooked. Twenty years ago the subject was kept very much alive by the many wordy battles of the cellular pathologists, with some creditable experimental work, as to renal hypertrophy versus renal regeneration. Apparently the complete victory of the former has left the subject flat and without interest. The remarkable advance in renal diagnosis and renal surgery since then calls for a revival of interest and study, but with an entirely different viewpoint.

The problem of the choice of the better or best operative procedure in the treatment of many renal conditions is still difficult in spite of improvement in the methods of diagnosis and in surgical technic. Mistakes are by no means as frequent or at all comparable to those made before the common use of the cystoscope and ureteral catheterization. But occasionally any surgeon practising in the field of the urinary tract will meet with an unlooked-for result, both in the way of success as well as of failure, and in the case of failure will wish when it is too late that in place of being conservative he had been radical, or vice versa. Some of these surprises can be attributed to technical errors, some to compensatory hypertrophy, but many of them cannot be so easily explained. It is in this latter group that a reconsideration of renal compensation is particularly pertinent.

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[1] Read at the meeting of the American Association of Genito-Urinary Surgeons, Washington, D. C., May, 1922.

It is the purpose of this paper to present a study of some experimental and clinical examples of renal compensation with this surgical aspect particularly in mind. Heretofore renal reserve and compensatory hypertrophy have been the sole factors recognized. We shall endeavor to show that renal competition and disuse atrophy are factors that must be reckoned with in the counterbalance that follows many surgical procedures on the kidney, and renal disease without surgery as well.

The body has normally a relative amount of renal tissue. A large individual will have large kidneys and a small individual, small kidneys. If in development one kidney only is formed it will equal the weight of what two normal kidneys would. If in development one large and one small (infantile) kidney are formed the two together will equal the weight of two normal ones. If there is destruction of renal tissue by disease, trauma or operation, that part remaining uninjured or the least injured will attempt to take over the lost function. For this counterbalance nature has provided a certain reserve, but this native reserve is quite limited and unable to carry for any length of time any sort of an added burden. Renal tissue meets this demand, if at all continued, by growth, by compensatory hypertrophy. According to the nature and portions of injury this compensatory growth may be a unilateral mass hypertrophy or a circumscribed group hypertrophy. It requires a period of time for its completion and is roughly proportional to the functional demand. Doubling the demand never results in doubling of the renal mass by hypertrophy. But the demand may be so great as to overwhelm the tissue and an actual atrophy from excess of function results, whereas, if the demand is gradually increased a much greater burden eventually will easily be borne. Renal reserve therefore is potential and not actual and is measured by the degree of hypertrophy that is possible. Regeneration of renal tissue does not occur in response to an increased functional demand except in the very young. The degree of hypertrophy possible is very great. One-third (one-fourth under conditions of gradual reduction) of the normal renal mass may so hypertrophy as to counterbalance the loss of the other two-thirds (or three-quarters). There is no mention in the literature of renal atrophy from loss of function as a factor in renal counterbalance.

The problem of renal counterbalance is complicated and made more interesting by the division of the renal mass into two equal and separate portions. This anatomical partition has been long regarded by surgeons as a blessing but may often prove to be misleading. It establishes an obvious competitive basis for renal compensation. Injury more frequently affects one portion, and competition between this and the remainder is thus rendered unequal. We may take economics of industry in point of illustration. The renal mass and renal function may be said to represent an equilibrium respectively of supply and demand. The demand, or the total renal work required, shows general variations only, such as occur with the growth of an individual and the normal fluctuations of excretion following changes in diet and exercise. But the supply, or the total renal tissue that performs the required work, may show marked alterations. Usually these changes are those of loss or insufficiency as a result of disease, trauma or operation. But occasionally the change may result in a surplus of renal mass or supply, as, for example, after the removal of ureteral stones or after repair operations in hydronephrosis. The process of a reëstablishment of an equilibrium of supply and demand that follows these alterations in the supply or demand is the process of renal counterbalance. Injury from disease, trauma, etc., or surgery are responsible for the anatomical alteration by which tissues are thrown out of balance, and the establishment of a final anatomical counterbalance may take years for its completion, even though compensation of function is effected within a few days. In the establishment of such an anatomical counterbalance we believe that, first, compensatory hypertrophy as a result of the action of increased functional activity upon renal reserve, and, second, disuse atrophy as a result of loss or diminished functional activity through an unequal competition with the above are important factors.

One can think of numerous animal experiments to test the correctness of these statements regarding renal counterbalance. Such experiments were begun by us in 1916. The results have all been confirmed by at least three, and in some cases eight, repetitions. Some of the experiments require a period of about two years for their completion, and this being realized beforehand, three to four animals were run together. After the completion of the initial experiment the result was often so striking as to lead to the necessity of a control experiment of like duration.

The relationship of reserve power and of competition to renal compensation will appear more logically if dealt with separately.

Renal reserve and compensatory hypertrophy

1. As observed anatomically. The simplest experiment that will test renal counterbalance is nephrectomy. A healthy kidney is thus suddenly burdened with just double the work to which it is accustomed. Complete ligature of one ureter accomplishes as effectively as nephrectomy the development of a compensatory hypertrophy. We have been able to study over 400 hypertrophic rat kidneys after complete ligature of the opposite ureter for periods of one to six hundred or more days' duration. The hypertrophic changes as measured by an increase in the size of the kidney were complete on an average of twenty to thirty days. There was no demonstrable increase in size beyond this period, even of those kidneys doing double duty for almost two years. In no case was the size of the kidney doubled nor did the increase ever even approach to this degree. In figure 1 is shown a series of hypertrophic rat kidneys typical of the different periods, and in table 1 the measurements are summarized. It is seen that the average total increase is 20 per cent of the normal.

Hypertrophic kidneys of rabbits, cats, dogs and pigs after opposite ureteral ligature have also been studied, but in relatively small series. The findings correspond to those for rats. Doubling of renal tissue by hypertrophy has never been observed.

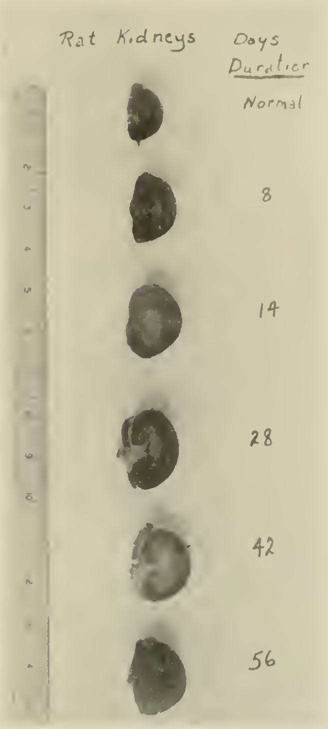

FIG. 1. Photograph (¾ size) of the hypertrophic kidney of rats of similar weight and age at varying periods after opposite complete ureteral ligature. The kidneys of twenty-eight, forty-two and fifty-six days are practically all of the same size.

TABLE 1

Measurements of hypertrophied right kidneys in rats after total ligation of left ureter

DURATION OF HYPERTROPHY	AVERAGE KIDNEY MEASUREMENTS			NUMBER OF RATS REPRESENTED	AVERAGE WEIGHT OF RATS
	Length	Width	Depth		
	cm.	*cm.*	*cm.*		*gms.*
None; normal	1.63	0.90	1.01	30	194
4 days	1.63	0.90	1.03	7	192
8 days	1.87	0.93	1.03	10	196
14 days	1.90	0.96	1.05	21	201
28 days	1.90	0.92	1.09	20	193
42 days	1.95	0.99	1.15	17	197
56 days	2.00	0.97	1.12	14	195

The histologic changes of compensatory hypertrophy vary with the period of examination. There are three distinct stages: First, the initial congestion, second, the active mitosis and growth, and third, the final equilibrium of hypertrophy. It is difficult to understand how there can be increased functional activity during the initial hyperemia that overwhelms a kidney with the sudden demand for more work. The picture closely resembles an acute inflammation with diapedesis, swelling and leukocytic infiltration. That there is an increase of function shows how dependent renal activity is upon blood volume, which must be enormously increased. During the second stage the pronounced karyiokinesis of cells is apparently an attempt to repair the acute damage and to meet the new demand by hypertrophy. The complete hypertrophy of the third stage

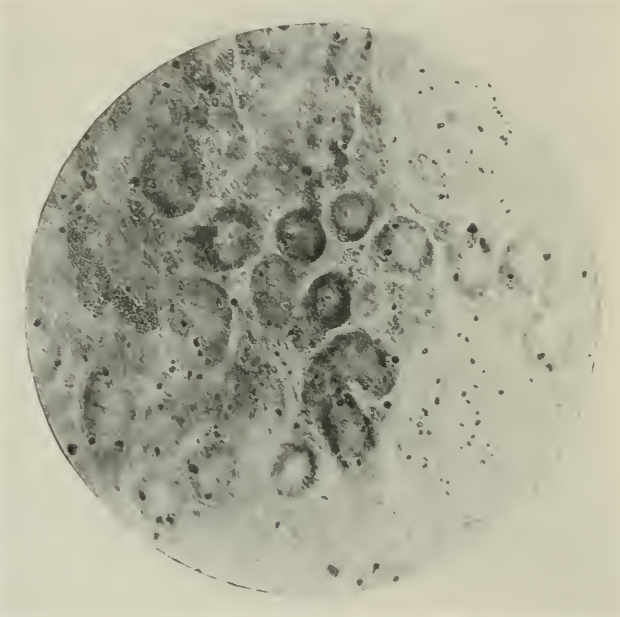

Fig. 2. Microphotograph (high power) of normal rat kidney stained intravitally. The convoluted tubules only take the stain. Compare with figure 5, a hypertrophic rat kidney similarly stained and magnified.

is proportional in a way to the demand. Hypertrophy is a relative term and a cell may grow slightly or double or treble its original size, and apparently the size it attains is dependent up to a certain limit upon the degree and progressive character of the strain to which it is subjected. In figure 2 is shown a microphotograph of a normal rat kidney stained intravitam with diamin blue, and in figure 3 a hydronephrotic repair hypertrophy.

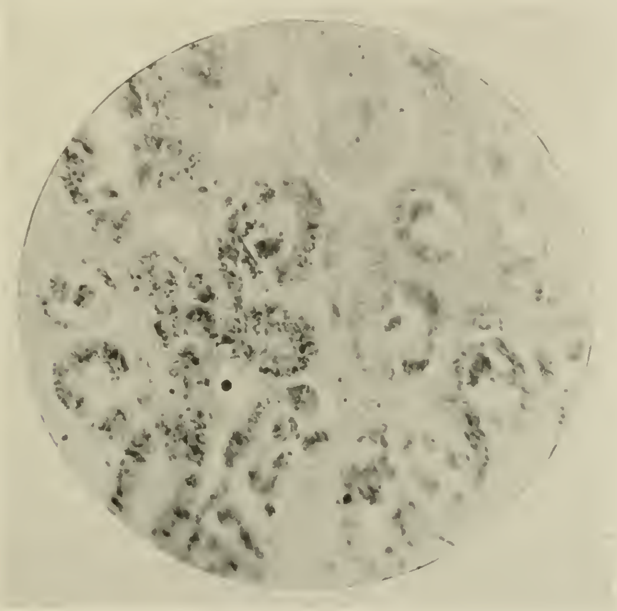

Fig. 3. Microphotograph (high power) of a hypertrophic repair nodule (middle specimen of figure 5) stained intravitally, which shows more intense staining and greater hypertrophy even than that of a complete compensatory hypertrophy, and a remarkable hypertrophy as compared to the normal of figure 2, magnified similarly.

The difference in the size of these convoluted tubules is quite obvious. Both rats weighed approximately the same, 200 grams.

2. As observed functionally. The usual clinical supposition is that the native reserve power of a healthy kidney is sufficient to do double the amount of work on demand. The number of individuals who have weathered nephrectomy with no functional disturbance of any kind is its warranty. So far as ordinary tests go, such as the amount and concentration of the urine, blood nitrogen and phenolsulphonephthalein output, the remaining kidney is just about equal to the task. But if the least overload is put on this kidney its insufficiency is at once apparent. Kutzmann,[2] in collaboration, has made carefully controlled and

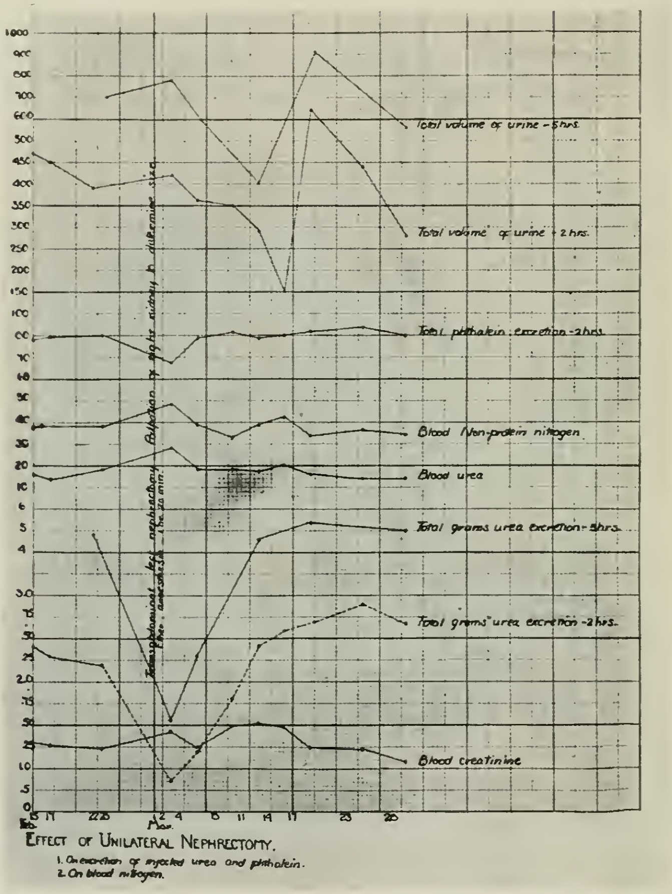

FIG. 4. The rise in blood nitrogen and fall in nitrogen and phthalein secretion shows definite incapacity of the reserve of one kidney to care for the loss of function of a kidney during the first few days after nephrectomy.

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[2] This work has not been completed for publication and I wish to thank Dr. A. A. Kutzmann, surgical interne, University Hospital, for his courtesy in allowing me to publish this part of it.

definite experiments in dogs to test this point. He finds that in the first two to three days after nephrectomy the excretion of urea and phthalein are definitely diminished and there is a corresponding rise of urea and non-protein nitrogen in the blood. A graphic chart of his findings is reproduced in figure 4. Phthalein is normal by the third or fourth day but urea excretion not until about the tenth or eleventh day. Putting the kidney under a greater strain by injecting urea prolongs the period of unbalance. A control experiment with dogs under ether for one hour, but without operation, gave no similar alteration in the phthalein or in the blood and urine nitrogen. Goldschmidt and Pearce have shown that splenectomy has no effect on renal function, so that it seems fair to rule out shock from operation or anesthesia as a contributing factor; and a just conclusion is that the native reserve of a kidney is insufficient to take care of as much as 50 per cent increase in work, and that this additional demand through increase of function leads to hypertrophy.

Renal competition and disuse atrophy

It has been shown that in the case of normal kidneys upon the removal of one the remaining kidney is at first unable to do the work of both and that it becomes competent to do so only after it has developed an hypertrophy. The questions naturally arise: When such an unilateral hypertrophy is complete, will it form a more or less independent renal system? Will it prove to be self-sufficient? Has it acquired a monopoly of renal function, and because of this can it now crowd off the market all inferior competitors? By surgical measures we can place different renal masses in competition and test such a law of survival of the fittest. It is understood that by competition we refer to quality of work and not quantity, and by unequal competition we do not refer to an unequal amount of work but to its relative ease and efficiency. An infantile kidney, for example, does much less work than its partner, but so long as it works efficiently it holds its own in competition. A repair hydronephrosis also does less work but inefficiently, and what will be the result when placed in competition with a perfectly capable hypertrophic mate?

Another experimental example other than repair hydronephrosis of disuse atrophy, which is rather unusual and bizarre and difficult of certain explanation, will follow transplantation of one ureter into the duodenum. The circulation of such a kidney has not been disturbed and it continues to get blood of the same quality as its fellow, but on account of a complete reabsorption of its products of activity its work is completely wasted and lost. In so far as a help to the opposite kidney is concerned, it might as well be completely removed, and the opposite kidney will undergo just as complete compensatory hypertrophy as if it had. But why should not the duodenal-transplant kidney likewise undergo a complete compensatory hypertrophy? And if it does, will it continue indefinitely to do double duty uselessly? These two sets of experiments will be presented separately.

1. *Experimental hydronephrosis.* The competitive factor in renal counterbalance and the subsequent disuse atrophy of renal tissue can be illustrated by comparison of the results that follow four types of experiments with hydronephrosis:

a. *The early result* of ureterocystoneostomy in hydronephrosis, when the opposite kidney is undisturbed.

b. *The late result* of ureterocystoneostomy in hydronephrosis, when the opposite kidney is undisturbed.

c. The result of ureterocystoneostomy in hydronephrosis, with opposite nephrectomy.

d. The result of ureterocystoneostomy in hydronephrosis, when the work of the opposite kidney is gradually destroyed by a partial ureteral obstruction.

There may be readers who feel that the late atrophy of experiment type b is nothing more than the result of the disturbance following ureteral transplantation and that transplantation of a ureter any place produces enough injury to lead to late atrophy provided the other kidney is healthy. The experiment just cited would seem sufficient proof to the contrary. An imperfect ureteral transplant leads by back pressure to renal injury, and the final atrophy in the above counterbalance experiments is no doubt hastened according to the degree of this injury; but the fact that by placing a need for this tissue delays or prevents atrophy (type c), whereas the lack of such need hastens it, indicates that in the latter case lowered function or disuse is an active factor in the late atrophy. The atrophy of a thirty-day hydronephrosis in view of its being opposed to an hypertrophied mate completely capable of doing all the work will obviously be faster than a kidney equal at the start with its unhypertrophied fellow when conditions are altered by ureteral transplantation. If the transplantation is at all nearly success-

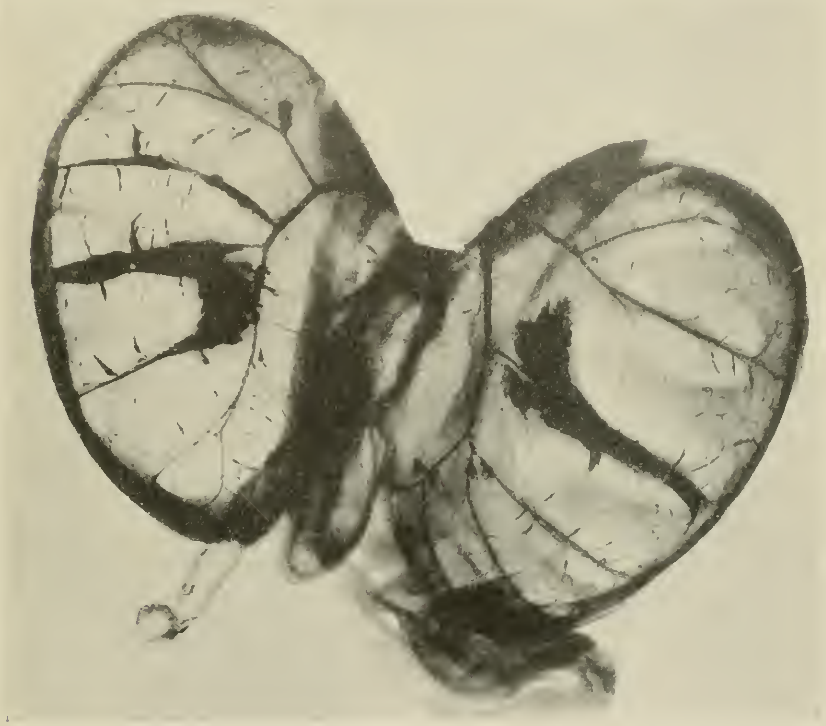

Fig. 5. (Dog 22-12.) Photograph of roentgenogram of barium sulphate arterial injection of a forty-one-day hydronephrosis in which the dog was sacrificed and barium sulphate solution injected at once after death. The attenuation of the circulatory tree of the hydronephrotic kidney is remarkable and is particularly significant when compared to the reproduced arterial tree of the kidney as shown in figure 5a, which, although a forty-two-day hydronephrosis, had had two days' relief from back pressure, due to ureteral obstruction.

ful such a kidney will never atrophy. There are many instances in the literature of vesical transplantation in which the kidney on the transplanted side has remained healthy for years. The

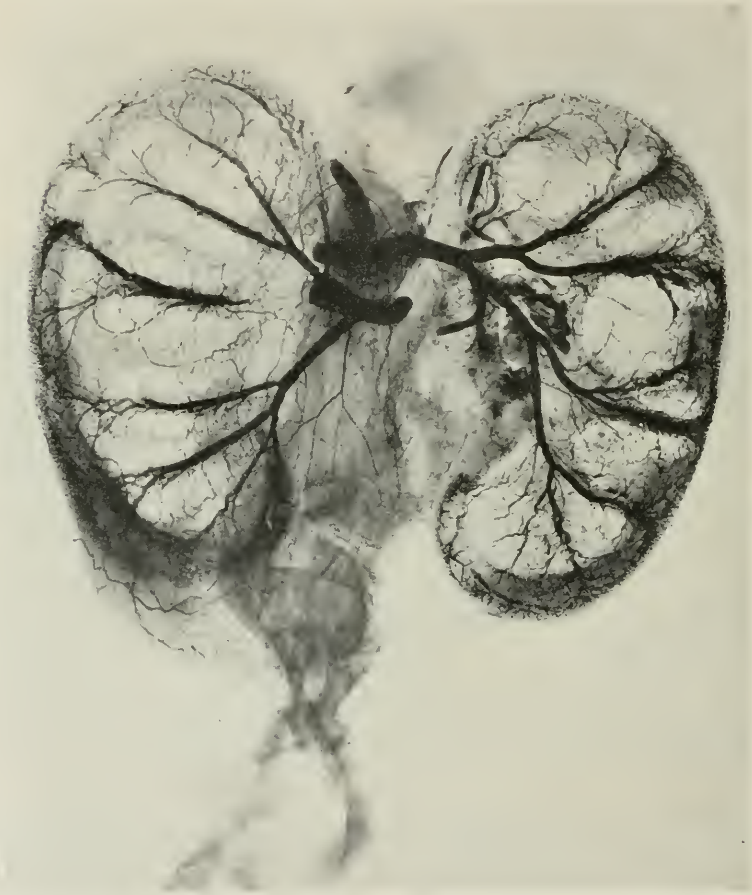

Fig. 5a. (Dog 22-36.) Photograph of roentgenogram of barium sulphate arterial injection of a forty-two-day hydronephrosis but in which the dog was sacrificed two days after the ureteral obstruction had been relieved. The same solution of $BaSO_4$ was used under equal pressures for both preparations shown in figures. Yet there is a remarkable revascularization apparent in the kidney relieved of the arterial back pressure, and this remarkable increase in blood supply must have been almost immediately after the removal of the intrapelvic pressure. It is significant of repair possibilities and of great interest in connection with the result in dog 21-39, figures 13 and 14.

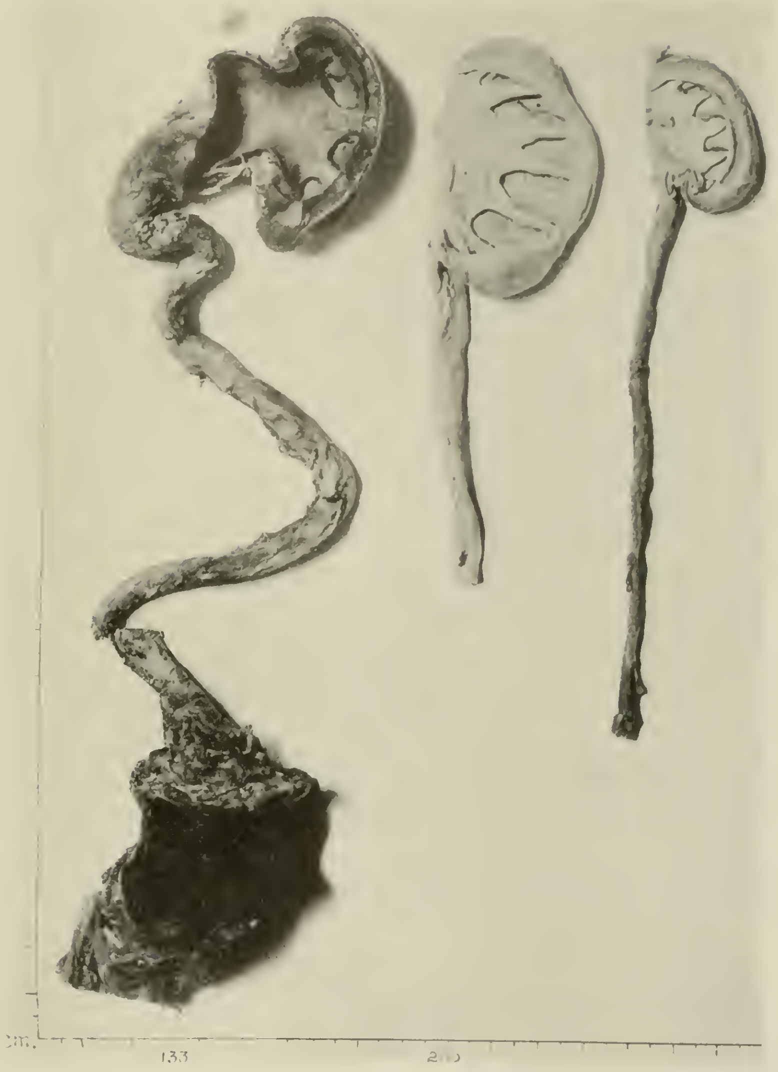

FIG. 6. Photograph (about $\frac{3}{4}$ size) of three hydronephrotic repair kidneys in dogs 17-13, 17-66 and 17-56. The first (17-13), with a capacity of 5 cc., is a seven months' repair after six months, partial obstruction, at which time the hydronephrotic sac held 895 cc. There is one repair nodule at the lower pole. The second (17-66) is a fifty-five-day repair after sixty days complete obstruction. There is a repair nodule at each pole. The third (17-56) is only a forty-five-day hydronephrosis but with three hundred and ninety days' competition with its hypertrophic mate, and shows complete atrophy.

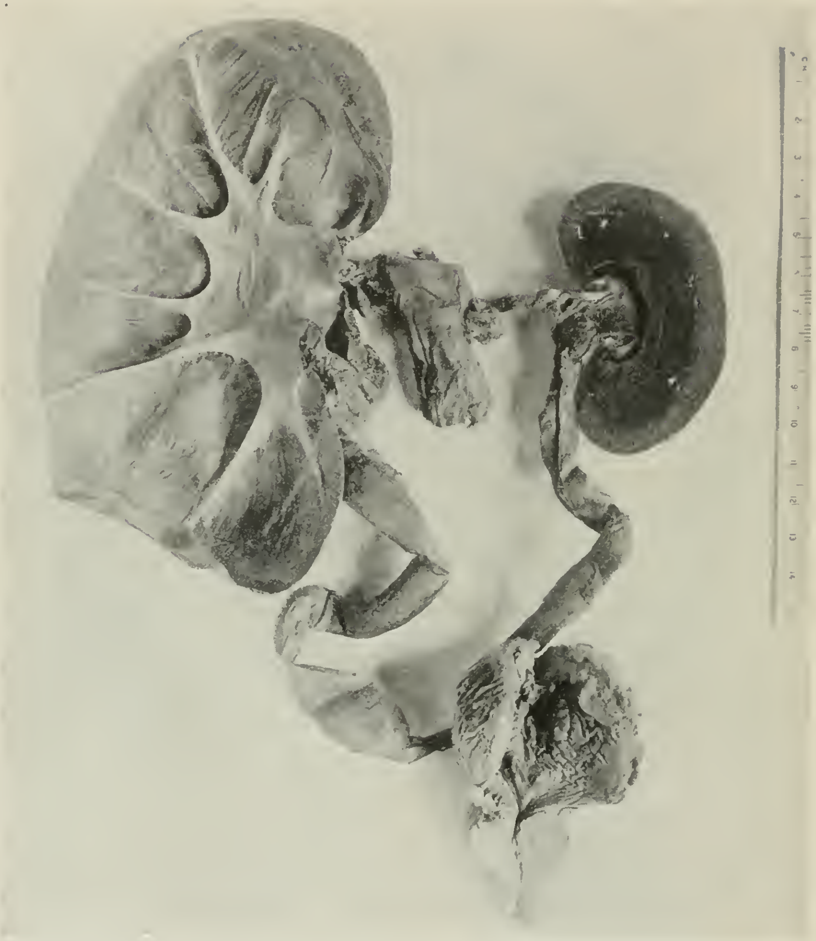

Fig. 7. (Dog 21-39, protocol 8.) Photograph of a thirty-one-day hydronephrotic repair days after ureterocystoneostomy and partial obstruction of the opposite ureter. The freely patent opening of the hydroureter into the bladder is marked by an end of a white match stick. This ureter has not shrunken and is almost as large as the opposite hydroureter belonging to an almost complete hydronephrotic atrophy. This kidney therefore must have been after its thirty-one-day complete obstruction markedly hydronephrotic and in every way analogous in size and condition to the simple thirty-day hydronephrosis shown in figure 10. The difference between them is quite evident after section. The thirty-one-day hydronephrosis has shrunken considerably but preserved its kidney shape and undergone a remarkable repair. There has been a complete anatomical counterbalance, now the previously dead kidney is doing normal and double function and the previously compensatory side has undergone complete hydronephrotic atrophy.

only cause for late atrophy when both kidneys are equal at the time of the transplant is injury from ureteral obstruction or from infection, either of which creates an unequal competition from a qualitative standpoint. Coffey has had dogs survive for many months after unilateral uretero-rectal transplantation, and the kidney on this side found to be normal and equal to its mate, and Carrel has had dogs survive for two and one-half years after kidney excision, perfusion and then inversion in Locke's solution for 2 hours when it was transplantated back in place and the ureter sutured together and opposite nephrectomy two weeks later and finds the animal in good health and the kidney normal in appearance after this long period. Perhaps his result would have been quite different if the good kidney had remained undisturbed. This question of the injury to a kidney in consequence of ureteral transplantation is of significance in the interpretation of the results of the following experiments.

2. Ureteroduodenostomy. When a ureter has been successfully transplanted into the duodenum the kidney will continue to function but its work is as completely nullified, so far as urinary excretion is concerned, as by nephrectomy, since there is complete urinary reabsorption.[3] An analogous result would follow the transplantation of a ureter into a vein, an experiment actually performed by Reid. What happens to the transplanted kidney? Will it hypertrophy or will it atrophy?

The accompanying illustrations of the early and late changes after ureteroduodenostomy show a great difference. After the first few months there is a bilateral hypertrophy (fig. 8), but after one to two years this earlier hypertrophy has undergone partial or complete atrophy (figs. 9 and 10).

The explanation of the early hypertrophy of the right kidney following transplantation of the ureter into the duodenum seems obvious. It is burdened with the same double load as its undisturbed mate and it is natural that it should undergo a similar hypertrophy. But the reason for the late atrophy is not so simple. Progressive degeneration from infection or back pressure as the cause is not entirely eliminated by the absence of evidence of either. In a number of the experiments of short-period transplant an imperfect transplant caused hydronephrosis, sometimes of considerable degree, and it is reasonable to suspect this early back pressure as being the cause of the late atrophy even when evidence of back pressure at this time is wanting. The marked difference in the histologic appearance of the atrophy of disuse in these kidneys and the degeneration from infection and hydronephrotic atrophy in the others

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[3] This subject has been more fully dealt with in collaboration with Dr. A. E. Belt in a paper upon ureteral transplantation presented before the Urological Section of the A. M. A., May 22, 1922, at St. Louis.

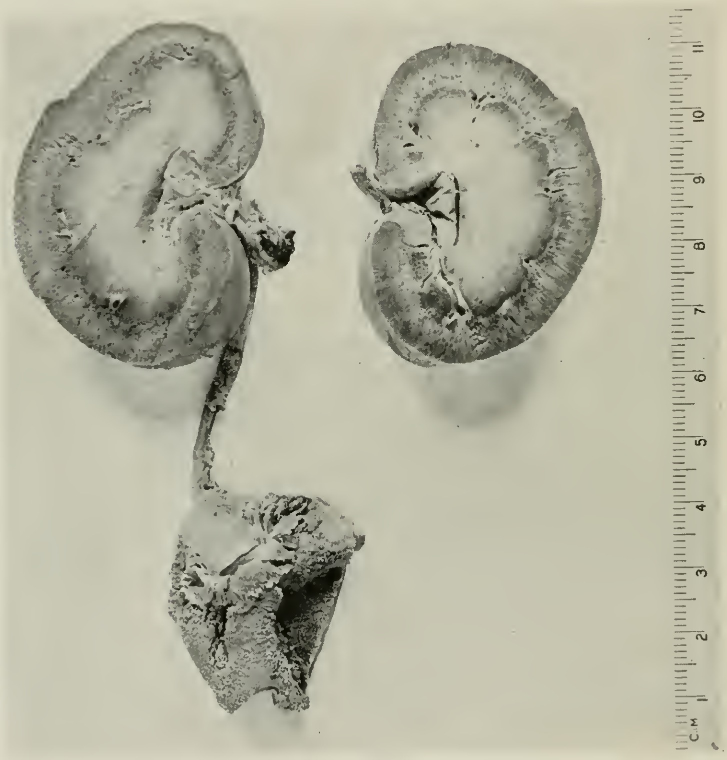

Fig. 8. (Dog 19-139, protocol 13.) Photograph of the two kidneys of bilateral hypertrophy after sagittal section. The hypertrophic condition of the transplanted kidney is apparent and there is no evidence of urinary obstruction, no pelvic nor ureteral dilatation.

allays to a certain extent such a reasonable suspicion and constitutes the main support of the correctness of our original assumption that the renal tissue does less and less work and so finally atrophies from disuse. But differences in tissue resistance to the injurious action of even a moderate bacterial toxin over a long period as a necessary sequence to differences in tissue activity and inactivity must not be overlooked and would undoubtedly tend to hasten an atrophy of disuse, if nothing more. The appearance of renal fibrosis in some of these late atrophies and the marked interstitial changes present closely simulate the chronic fibrosis of old nephritis and arteriosclerotic changes. We therefore hesitate to offer an explanation of the late atrophy after duodenal transplantation. Conditions are not analogous to those in repair hydronephrosis. Competition as a factor is absent. Yet the transplant kidney impresses one as having atrophied more from disuse or diminishing activity than from either back pressure or infection. The almost total destruction that is found in one year would require marked evidence of hydronephrotic atrophy

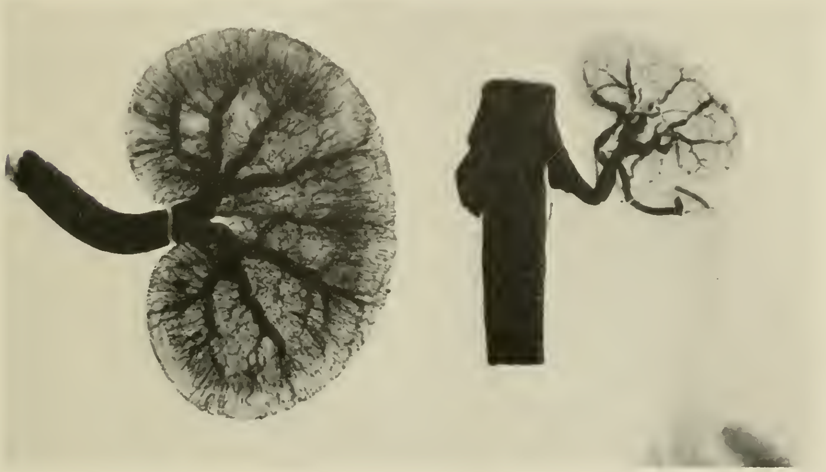

FIG. 9. Photograph of x-ray plate of right (small) and left (large) kidneys (Dog 21-37, protocol 19) cut sagittally after arterial injection with $BaSO_4$. The shrinkage of the arterial system corresponds to that of the parenchyma, both of which are pronounced.

in the one case and of pronounced infection, such as pyonephrosis, in the other. The implication of disuse or gradual loss of function as a factor—although it may not be the sole factor—in the late atrophy seems necessary. But how explain the loss of function? How does this kidney learn to work at a slower pace than its divorced fellow? The demand for work would seem to be exactly the same for it as for the undisturbed kidney, inasmuch as they get an equal load in the blood for excretion. Possibly ureteral transplantation is impossible without some renal damage, either by back pressure or infection, and this initial injury puts the transplant kidney qualitatively to a disadvantage. If this were true you would have difficulty in

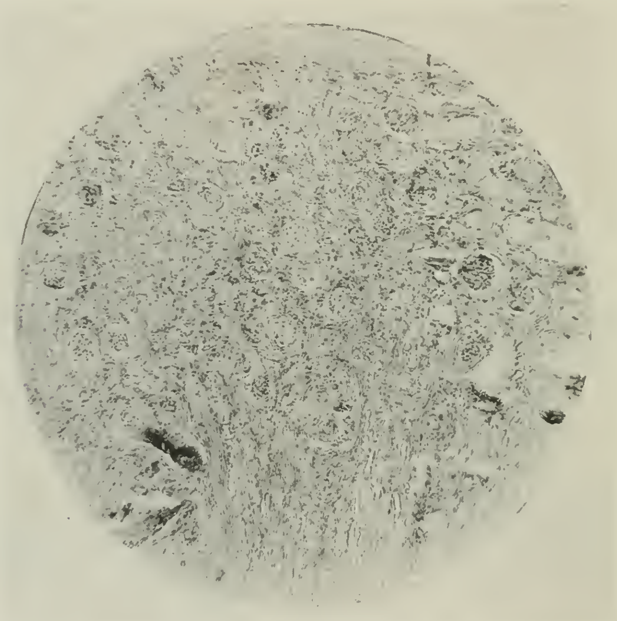

Fig. 10. (Dog 21-37, right kidney.) Microphotograph (low power). Histologic evidence of disuse atrophy, the late atrophy that occurs after ureteroduodenostomy. Marked fibrosis and particularly well marked hyaline degeneration of glomeruli. Tubular system replaced by fibrous strands. Gives the appearance of a chronic fibrosis of Bright's disease.

explaining the early compensatory hypertrophy of this transplanted kidney. Compensatory hypertrophy is marked even in those kidneys with definite hydronephrosis from an imperfect duodenal transplantation. We can think of the following explanation as a probable factor.

Two normal kidneys may be likened to a well paired team of horses. The stay chains of the double-tree may be tightened periodically, first on one side and then on the other, as one or the other opposite member of the team slacks up in pulling the load. But in the course of the day each horse will have done an equal share of the work. So with two kidneys. Work is not continuously and uniformly equal. This would seem to be a well established fact, as first pointed out with emphasis by Albarroan. First one and then the other slacks up for a short period. But the work undone must be finished and the added load is put up to both kidneys equally, so that when measured over a long period they will each have done a proportionate share of the total work. In the experiment with right uretero-duodenal transplantation the two kidneys are put out of balance, and now they cannot be compared to a team of horses. Coöperative competition is removed. The stay chain on the left is continuously strained and whenever the left kidney slacks in its efforts it alone must later make up for its short vacation. It gets no aid from its divorced fellow. Renal work is completely dependent upon it, and it alone. But the stay chain on the right may be slackened with impunity. No additional burden will result to either the right or the left kidney thereby, and the right side will gradually take a longer and longer rest, or will do work less and less efficiently, until it will finally atrophy from disuse. In the earlier periods, however, before left hypertrophy has occurred, the double stimulus in the blood activates the right kidney to a similar degree. It has an ever present demand for more work than it is doing and its functional activity is stimulated to the optimum, so that in consequence it hypertrophies. With the completion of a perfect compensatory hypertrophy on the left side the added stimulus is now removed from the blood and the right kidney begins to suffer from the slow

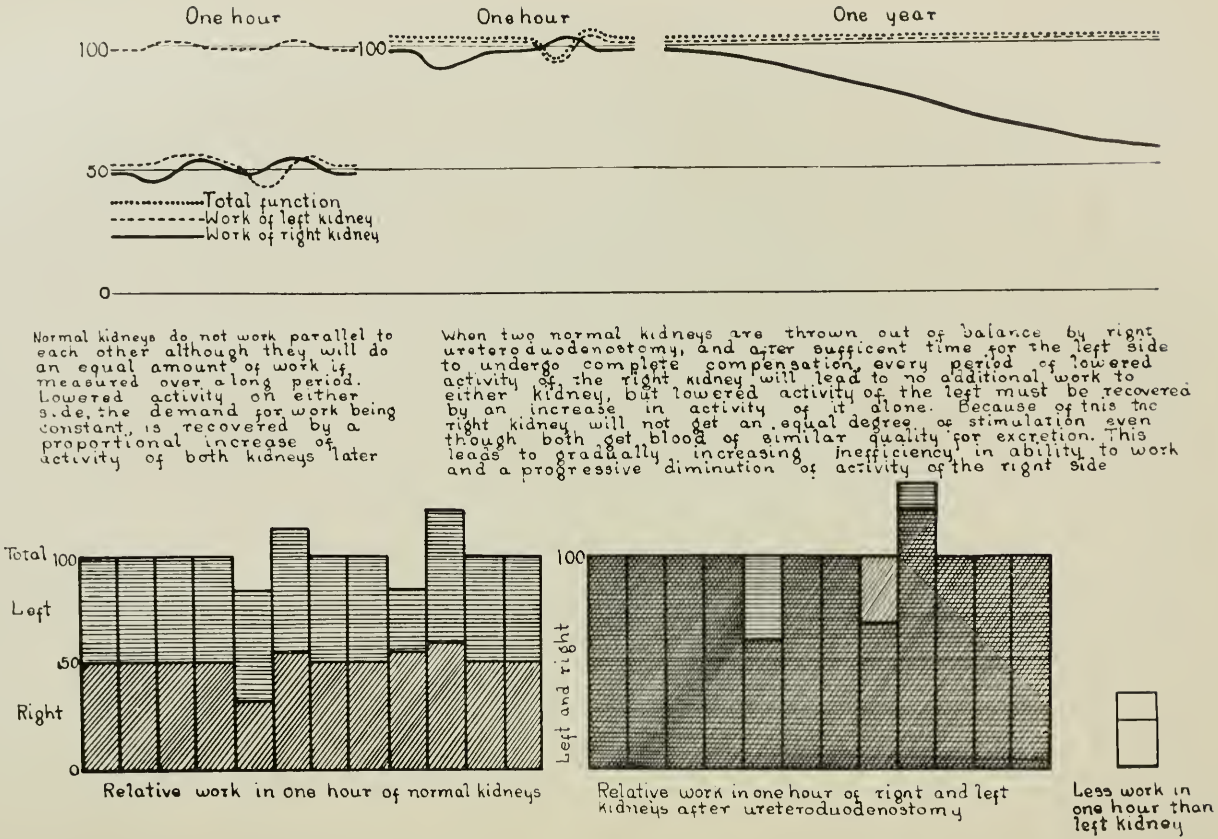

FIG. 11. Diagram to illustrate possible explanation of late atrophy after uretero-duodenostomy as largely a disuse atrophy. Competition is indirect though not entirely removed. Injury to the transplanted kidney would create an unequal efficiency. But provided an injury occurred would an unequal variation in function lead to a disuse atrophy?

injurious effects of inaction in consequence of normal rest periods, which when prolonged lead to its final and complete atrophy. This idea for the sake of clearness may be diagrammatically represented as in figure 11.

Summary of experimental study

The above experiments demonstrate the occurrence of renal counterbalance, illustrate the difference between a functional and an anatomical compensation in renal work, and show the slow progressive nature of the latter, which may be complete only after many months or years. They emphasize the fact that the anatomical is the only type of counterbalance for serious consideration surgically. In the establishment of this anatomical counterbalance four factors are found to be active, of which two are primary, renal reserve power and renal competition; and two are secondary, compensatory hypertrophy and disuse atrophy.

Renal reserve refers to the potential strength or power of renal tissue to perform more work on demand. Its native or static reserve is limited and when the demand surpasses this limit, hypertrophy to a necessary though limited degree occurs. This ability to hypertrophy on demand may be called the compensatory reserve of renal tissue. But if this compensatory ability is competent the physiological inertia of renal cells will overcompensate and thus acquire a comfortable margin of strength for an occasional overload, which may be termed the acquired reserve.

The usual anatomical division of renal tissue into symmetrical and equal halves and the frequency of unilateral injury signalize the surgical importance of renal reserve. Excretory work and renal supply ordinarily balance. The former considered as a whole is fairly constant but alterations in the supply, by disease, injury or operation, are frequent and the anatomical separation of the renal mass accentuates these changes. The anatomical counterbalance may be relative. Complete destruction on one side has not occurred. Changes in the supply on one side, therefore, will either diminish or increase the demand on the other as well as on itself, since they will both have blood similarly loaded with excretory substances. In the process of establishing a new counterbalance of renal tissue on the right and left side as a result of this alteration there will be an active competition between their relative reserve strengths, which may lead to a progressive hypertrophy on one side and a regressive atrophy on the other.

When all renal portions on the right and left kidneys have a relatively similar reserve power they will undergo proportional changes in the process of anatomical counterbalance secondary to alterations in the supply or demand. There will be an even reapportionment of functional activity and a coöperative type of anatomical compensation.

When the renal substance that is thrown out of balance has dissimilar reserve power and potential strength, competition renders counterbalance also disproportional, and that side or portion with the bigger and healthier reserve will show the greater compensation, the weaker side gaining little or nothing in functional strength by reason of the increased demand. The stronger side will gradually outstrip the weaker and by compensatory hypertrophy may be so capable of counterbalance as to render the work of its weak assistant unnecessary, disuse atrophy of which will then follow.

CLINICAL SIGNIFICANCE

Anyone at all familiar with renal surgery will recall many opportunities to observe and study renal reserve and compensatory hypertrophy. Experience with polycystic kidneys teaches with how small an amount of renal tissue an individual may live in apparent health. But these kidneys are working to the height of their ability, are unable to hypertrophy and break down when a demand for more work arises. Similar conditions occur in cases of chronic nephritis. It is of interest in this connection to mention the beneficial effect of morcellement in the one case and of decapsulation in the other. Relief of intrarenal pressure in both allows an increased blood supply and a compensatory group hypertrophy to occur, and in consequence an improvement in function. Pousson (19) has mentioned this as the more probable explanation of the action of Edebohls' operation than that the kidney circulation is improved by a new capsular blood supply.

The clinical problem in relation to surgery is, first, the determination of the renal reserve and ability to hypertrophy of the respective renal masses, and, where the surgical preservation of tissue is in point, the further determination of the probable action of competition and renal atrophy in the final counterbalance. For relative functional study those tests that put renal tissue under strain would seem to be more valuable in this connection. We lack such a test with ureteral catheterization and have to rely upon a consideration of the pathological processes as best we can determine them, together with the relative functions shown. It will be seen that renal counterbalance, with its factors of reserve and competition, is a much broader basis for the consideration of problems of renal surgery than relative functions alone, since it presupposes an attempted foreknowledge of the final result.

Renal compensation has an important clinical significance and should be considered from an anatomical as well as functional standpoint. Functional counterbalance has reference mainly to total function and in this limited sense counterbalance is complete whenever renal function is normal. But the anatomical changes may not be complete for many months or years later and therefore the process of an anatomical counterbalance has reference to the relative ability of a right and left kidney rather than to total function. Functional tests are of particular value as indication of relative strength but they do not permit an accurate anatomical correlation and therefore anatomical counterbalance is difficult of clinical application. The anatomical changes are gradual and progressive and cannot be definitely measured by relative function. Such tests, however, in conjunction with a knowledge of the pathology present in each kidney, help one to a fairly clear clinical inference of the compensatory changes and their present and potential extent. The end result, when the anatomical counterbalance may be said to have reached a stationary equilibrium, is primarily dependent upon the relative native or potential reserve strength of the two kidneys. When this is qualitatively equal an even or coöperative type of counterbalance results, but when unequal the nature of the competition created thereby causes growth by compensatory hypertrophy in response to increased functional activity or degeneration by disuse atrophy secondary to diminished or lost function.

Complete compensation in an anatomical sense may be used to define an unilateral compensatory hypertrophy of a functional degree and ability equal to that of two normal and healthy kidneys.

Partial compensation may be used to refer to the anatomical condition of a beginning but incomplete unilateral compensatory change and may occur under three circumstances: First, insufficient time for the development of a complete hypertrophy; second, no need for a complete compensation in view of considerable work still being performed by the other kidney; and third, inhibition of hypertrophy, or, rather, of an increase of function that would lead to hypertrophy, by the injurious action of the disease in it or in the opposite side.

What may be called renal decompensation or failure of a counterbalance will be indicated functionally by renal insufficiency and implies anatomically a condition in which compensatory changes cannot occur on account of the fact that renal tissue is already working to the height of its ability. These various considerations may be diagrammatically represented, as in table 2.

The surgical significance of the above experimental and clinical consideration would seem to be two-fold, in accordance to whether the surgeon is dealing with a unilateral or bilateral lesion, and may be summarized as follows:

1. It is useless to attempt preservation or repair of an unilateral injury in face of a healthy and complete compensatory hypertrophy on the opposite side. Therefore attempts to repair must be made before anatomical compensation is complete, and in distinctly unilateral lesions the outcome is always questionable because even a partial compensation of a healthy kidney may in time become complete through the competitive elimination

TABLE 2

Native reserve with potential ability to do more work		Renal tissue	Reserve power absent, working to height of ability already		
A	*B*		*D*		*E*
Renal hypertrophy	Inhibition of hypertrophy	Demand for more work arises	Unable to hypertrophy	or	Has reached maximum stage of hypertrophy
Partial or complete compensation with development of an acquired reserve	Renal insufficiency	Result	Insufficiency		Insufficiency
	Remove inhibiting factor *C* Compensation by hypertrophy				
		Competition in response to the demand for more work or as result of surplus of supply			

A with A or with C = Coöperative counterbalance.

A with B, D or E = Partial counterbalance of A, which in case of its marked superiority may lead to a complete compensation of A and a gradual disuse atrophy of B, D or E.

B with B = The anatomical change will be relative to the respective value and strength of each.

C with B = Same as A with B.

of its less efficient repair mate. It is only in those conditions where the competition between the two sides is equalized qualitatively by the conservative repair procedure on the diseased side that a coöperative counterbalance can be expected.

2. In bilateral conditions conservation of renal tissue should always be given the greatest consideration. Conservative surgery in these cases will often give wonderful results. But in the event of a two-stage operative procedure, each kidney being treated at separate operations, which is almost always required, the second operation must not be too long delayed, because by the first one the previous equilibrium of competition has been overthrown and the repair on the side first operated may be so stimulated and efficient as to render the work of the unoperated and still inefficient side unnecessary. Delay will lead to its final atrophy from disuse.

3. In such a case of bilateral injury with a successful unilateral repair but in which there has been delay in the second operation, the problem may now closely simulate that of unilateral injury with opposite compensatory hypertrophy, and in place of a conservative procedure as originally planned, radical nephrectomy may be to the best interest of the patient.

MEGALOURETER[1]

THE IMPORTANCE OF THE URETERO-VESICAL VALVE

JOHN R. CAULK
St. Louis, Missouri

Received for publication August 10, 1922

Anomalies of the ureter have ceased to be autopsy curiosities. Since the development of scientific Urology, they occupy a very important clinical position. The developmental errors are of three types; those of number, insertion, and caliber.

Irregularities in number are by far the most frequent. Abberations of insertion are, fortunately, the rarest, while variations in caliber hold an intermediate position and are the ones, with which we will concern ourselves in this paper. These variations have their foundation in faulty embryological development. I shall not busy you with a complete outline of the development of the urinary tract, since it is so admirably described in Huntington's Harvey Lecture, 1906, and very concisely by Bottomley in the Annals of Surgery, 1910, and by Young and others.

Since, in this paper, we are interested in the changes of caliber, let us refresh ourselves with the process of development which might have an influence on this feature alone. The first rudiment of the permanent renal system arises at the latter part of the first month of fetal life, as an outgrowth from the dorsal side of the Wolffian duct, close to its termination into the cloaca.

This bud develops in an upper direction and very promptly shows at its upper extremity a bifurcation, the forerunner of the renal pelvis. The mesodermal tissue surrounding the bifurcation and its branches, contributes to the formation of the renal parenchyma. This blastemal cap surrounding the renal pelvis is a very firm, resistant body, composed of two layers.

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[1] Read at the meeting of the American Association of Genito-Urinary Surgeons, Washington, D. C., May, 1922.

The ureteral bud from the Wolffian duct is, in the beginning, rather wide and narrows down to a uniform caliber by the end of the second month, at this time, wholly without musculature. At the beginning of the third month, muscle fibers appear next to the bladder, gradually extending upward, reaching the renal pelvis about the middle of the fourth month.

Constriction occurs at the point where the ureter passes over the pelvic brim. This is followed by two enlargements despite the muscle coat. The lumbar appearing during the fourth month and the pelvic, later.

The physiological constrictions at the uretero-pelvic juncture and at the bladder, also make their appearance. These three points of narrowing become more marked toward the end of fetal life as Seitz has shown, and were commonly found in the normal adult ureter by Robinson. In addition, there often occur valves, twists and tortuosities. It has been estimated that 20 per cent of cadavers of normal children have shown ureteral valves, which according to English, Duncan and Bazy are more commonly located within the bladder wall, that is the intramural ureter and play an important rôle in ureteral obstruction. The valves contain mucous membrane, submucous and muscular tissue. With this brief outline, one can see how an arrest or an imperfection of development or persistence of certain fetal structures may play an important rôle in determining the caliber of the ureter.

The most frequent type of change in ureteral caliber is enlargement. Abnormal dilatations occur with fair frequency and are usually attributable to congenital strictures or valves. Bottomley in 1910, in his article on congenital strictures, collected 56 cases. Eisendrath, in 1917, brought the number up to 67, having collected 7 others and added 4 of his own. The majority of these strictures were located near the bladder and in most instances were associated with marked enlargements of the ureters. In a few cases the stricture area was quite extensive, occasionally producing complete impermeability, the ureter being represented by a fibrous cord.

Tesseydre collected 11 such cases.

I shall not discuss the plurality of causes of ureteral enlargements. In substance, there are those secondary to obstruction and those produced by primary alterations in the ureteral wall itself. An association of the two may be expected. Whatever may be the cause of obstruction, the effects upon the ureter are the same, and consist almost invariably in the production of a thin-walled tortuous tube varying in caliber from that of a pencil to that of the small intestine showing kinks, windings, and twists. The wall of such ureters often exhibits valvelike folds, which according to Hamann represent the fetal type. In only 3 of Bottomley's collected cases, was the ureteral wall mentioned as being thickened.

The enlargements due to changes occurring primarily in the ureteral wall may be congenital or acquired—of these we hear but little. The changes in the ureteral wall from inflammatory conditions are familiar and aside from tuberculosis, seldom are they sufficient to cause caliber changes of much magnitude, the most constant observation being irregularity in outline. I am unable to find a description of an enlarged ureter incident to a primary congenital defect in the wall of the duct itself. Such a condition must be possible as it occurs in other structures of a somewhat similar physiology and anatomy.

EFFECTS UPON THE KIDNEY

In looking through the surgical literature and in consulting pathological and anatomical reports, I find that wherever there has been a dilatation of the ureter, there has usually been an associated dilatation of the renal pelvis. Indeed, the effect upon the renal pelvis has always been the more striking, ranging from a moderate retention to enormous sacs, completely destroying the parenchyma. Primary atrophy has occasionally been reported although recent experimental study does not bear this out. I can find no citation of an enormous dilatation of the ureter without either dilatation or atrophy of the kidney. If the ureteral dilatation be coincident to a partial obstruction, whether this be stricture or valve, the chances are that the pelvis of the kidney will suffer dilatation with the ureter. It is, however, possible that compensatory hypertrophy and dilatation of the ureter might be sufficient to protect the kidney pelvis against back pressure dilatation and may offer an explanation of the origin of the condition about to be cited.

Clinically, up until the time of Eisendrath's report in 1917, there had been very little surgical literature on the subject of congenital obstruction and dilatations of the ureter. Such hydroureters with their associated hydronephrosis are usually incompatible with life and most of the individuals die in infancy. A few, according to Bottomley die in old age; very seldom is the condition observed in middle life.

I wish to bring to your attention a condition of the ureter and submit to you the history and findings of a patient in whom it has been observed. Namely, an enormous dilatation of the ureter without demonstrable obstruction at the lower end without a corresponding enlargement of the renal pelvis and without changes of renal function, commensurate with such a degree of ureteral dilatation. I am inclined to believe that the ureteral enlargement represents a defect in the ureteral wall itself—in all probability of a congenital nature and comparable to the condition in the large bowel, particularly the sigmoid, which is known as giant colon, or Hirschsprung's disease. Entertaining this belief, I present it to you under the name of megaloureter.

Mrs. B. St. Louis; aged thirty-two; married. Seen first in January, 1920. Complaining of frequent, urgent urination and pain in the bladder when it is full.

Family history. There are no congenital abnormalities as far as patient knows in any of her parents, but patient has a child with a cleft palate and harelip.

She had suffered from profuse uterine hemorrhages for three years. The periods would last from ten days to two weeks, bleeding profuse, containing numerous clots. She had been curetted several times, without relief. She has had two children, one with harelip and cleft palate. There was one miscarriage about one and a half years ago. Severely torn with first child but repaired with good result. Had no fever or chills, or signs of kidney obstruction during pregnancy, but during the full period of gestation had an irritable bladder which was relieved after delivery. Has never had tonsillitis, but has repeated colds.

One year before admission, had her appendix removed. Three weeks before removal of appendix had persistent pain in lower abdomen and frequent, painful, urgent urination. Pain in abdomen was on left side, reflecting over to the right. Associated with this pain, there was an ache in the left kidney region. One tube and ovary were removed with the appendix. The appendix was tuberculous. She was relieved of the pain over the bladder after the operation, but has always had frequency of urination, amounting to every hour, day and night during the last year. Within the last few months, she has had pain in the lower left back of a dull aching character.

She has passed no blood. Has had occasional chills and fever. No sweats. There has been no loss in weight, but patient has been so fatigued and exhausted that she has been confined to her bed most of the time.

Examination. A well nourished young woman. Mucous membrane somewhat pale. Examination of heart, negative. Lungs show chronic bronchitis, no tuberculosis. Abdomen flabby, and except for tenderness along the lower left quadrant is negative. Reflexes normal. Neither kidney palpable nor tender.

Cystoscopy. Cystoscope passed and found very cloudy urine which showed upon analysis, specific gravity 1.016, albumin, no sugar. Microscopically pus and a mixed infection of staphylococci and colon bacilli. Bladder capacity 250 cc. Internal orifice somewhat irregular there being villous proliferations in the lower margin. Trigone hypertrophic and irregular with bullous edema running along the interureteric bar and the left margin of the trigone. No ulcer, stone or tumor in bladder. Ureteral orifices perfectly normal in appearance. Both catheters passed easily without obstruction. Urine from left side showed pus, colon bacilli and staphylococci. Right side normal. We were unable to find any tubercle bacilli from the left and guinea-pigs were inocculated several times, and always gave negative results.

A functional test with phthalein appeared in eight minutes on the left after intravenous and four minutes on the right. In twenty minutes 7.5 per cent on the left and 19 per cent on the right. Considerable retention noted from the left side. I took it that we were dealing with a left hydronephrosis which had interfered with the functional capacity of this kidney. X-rays were negative for stone, but

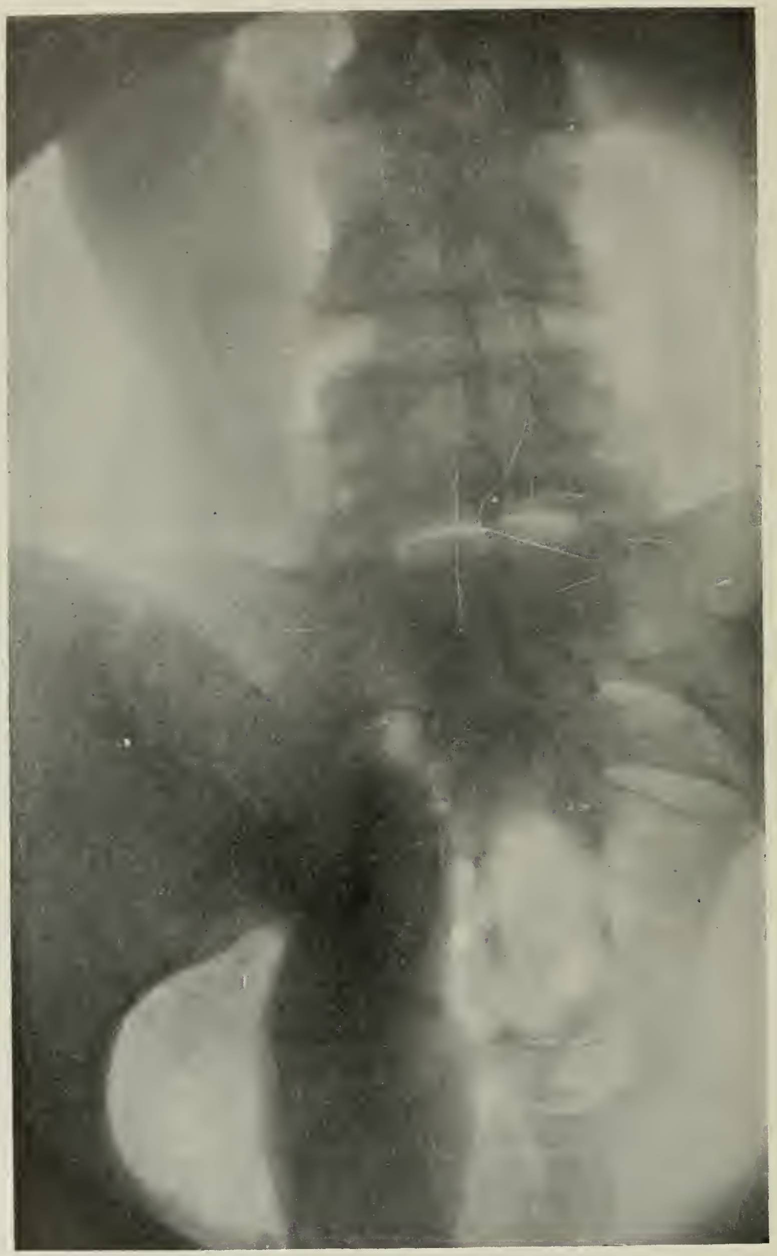

FIG. 1. SHOWING ENORMOUS DILATATION OF RIGHT URETER

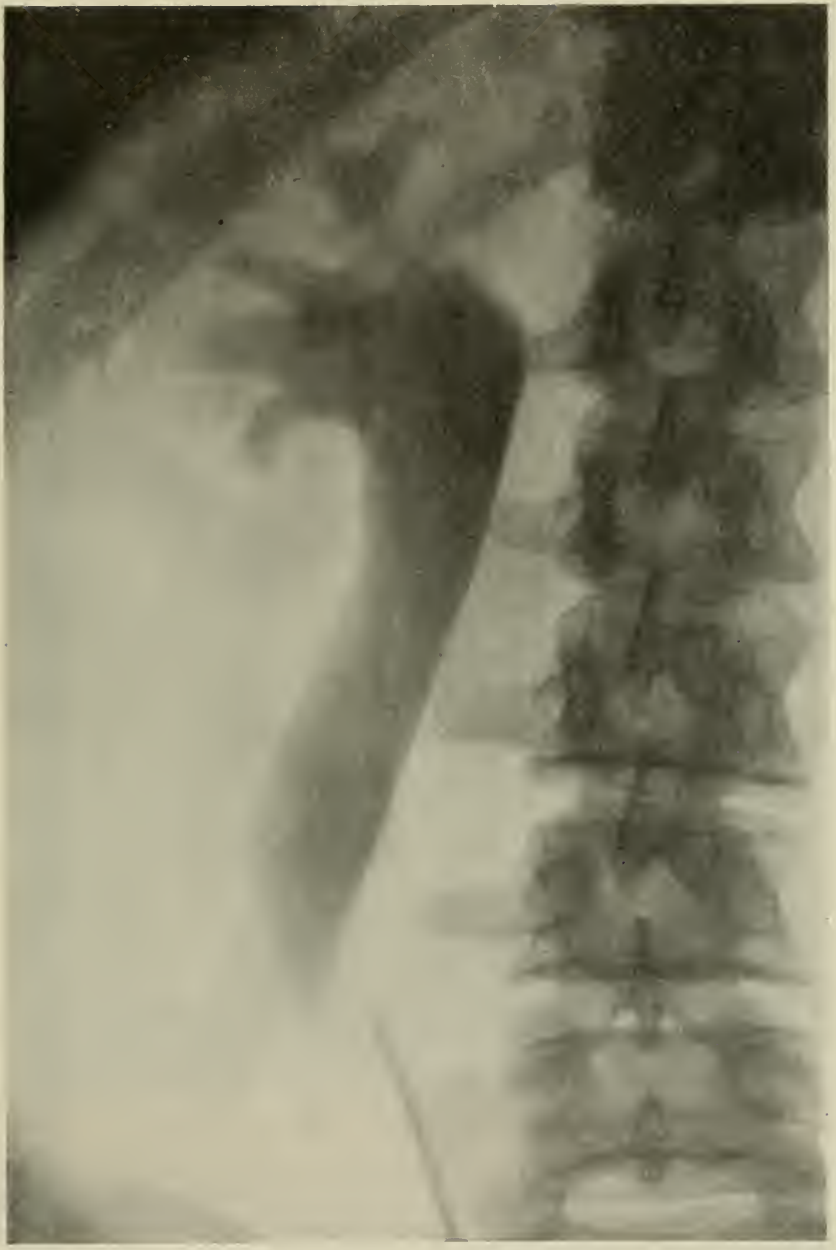

Fig. 2. No Dilatation of Renal Pelvis

there is seen along the left side, a broad tape like shadow which corresponds to the location of the ureter. Ureter catheterized a week later and 8 ounces of urine were drained from the left side. Specimen still contained pus, colon and staphylococci.

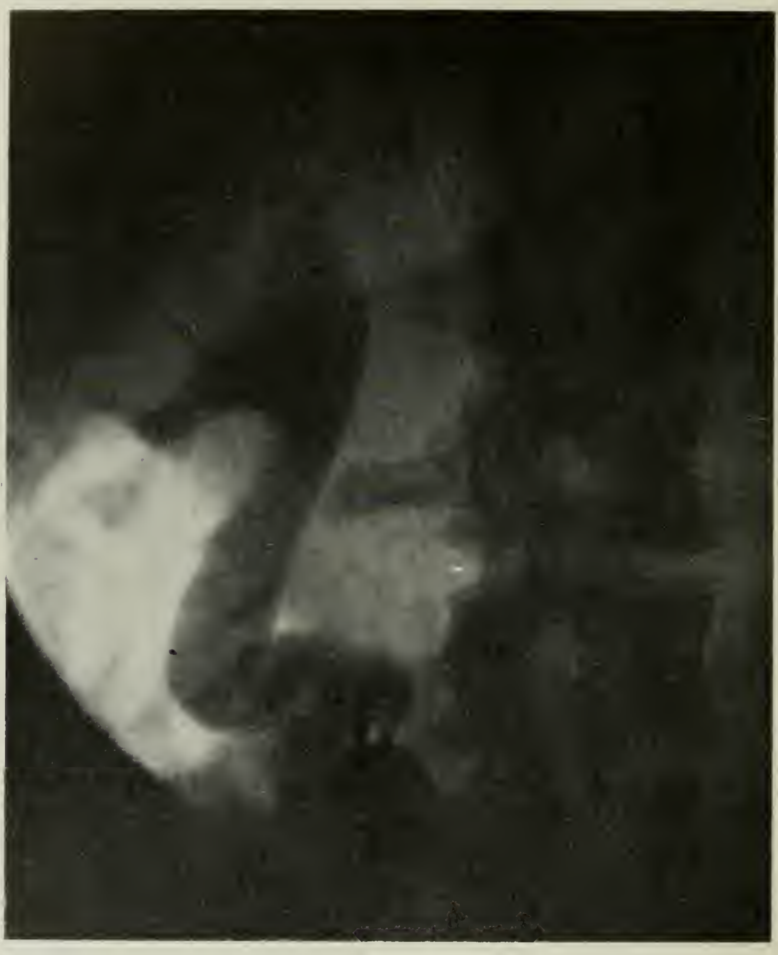

FIG. 3. TORTUOUS DILATED UPPER URETER; PELVIS NORMAL

Patient was then x-rayed with catheters in place and it was found that the catheter was curled upon itself down in the ureter, reaching not quite to the promontory of the sacrum. The ureterogram was then done and after putting in 9 ounces of sodium bromide, the pictures, as you see in figures 1 and 3 were obtained. Namely, an enormous dilatation of the ureter, particularly pronounced in the pelvic spindle, being at least 1½ inches in diameter and running directly upward with very slight tortuosity to the kidney pelvis.

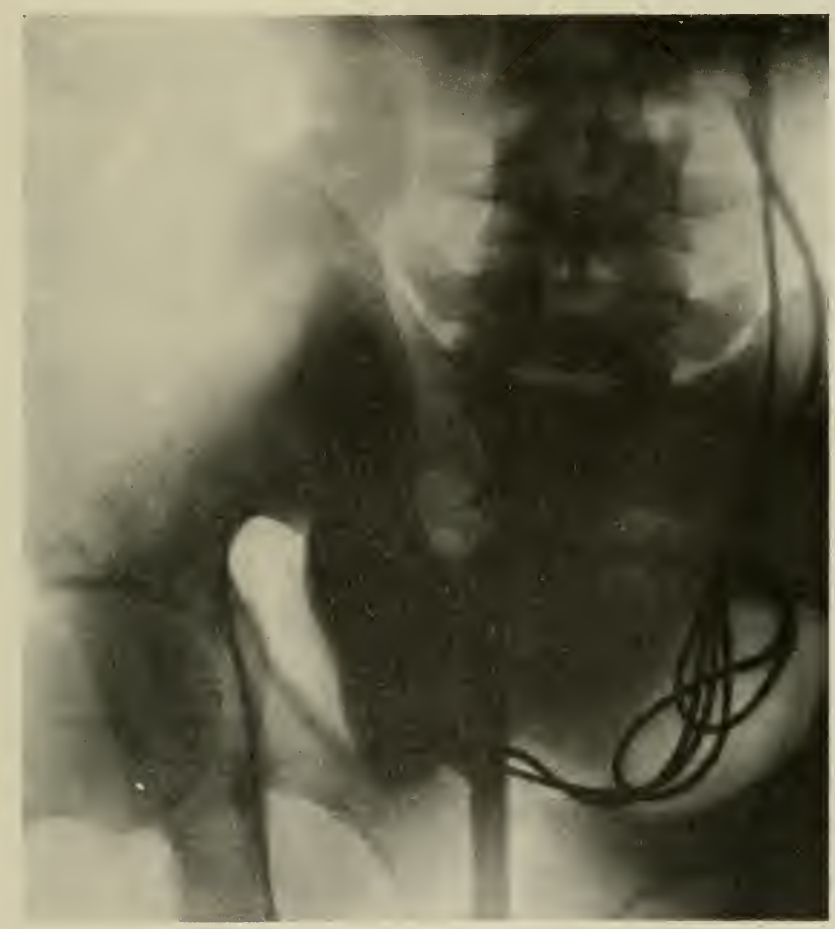

FIG. 4. DILATED, TORTUOUS RIGHT URETER; CATHETERS CURLED UP IN THE LEFT

The upper part of the ureter shows a straight, smooth line along its inner margin with practically no irregularities. This smooth symmetrical dilatation runs directly to the pelvis of the kidney, which preserves its normal conformity below, but at its upper margin shows a slight rounding. The true pelvis is slightly broader than it should be, but the calyces themselves are sharp and pointed and show not the slightest evidence of hydronephrosis. That is, signs of obstruction. In other words, there is an enormous dilatation of the ureter without dilatation of the calyces and only slight dilatation of the upper part of the true pelvis.

Pyelogram taken of the right kidney shows practically a normal pelvis and an undilated ureter.

At another time, after removing the retention from this ureter, a functional test was done and the function of the two sides compared, the right now puts out 24 per cent in thirty minutes and the left 32 per cent. It was evident that the previous low function of the left side was due to the fact that we did not get all the urine from the ureter. Another ureterogram was then done which showed the same dilataton of the ureter, starting bluntly at the juxtavesical ureter. I thought it was due to a congenital valve within the bladder wall since I was able to pass two catheters with ease through the ureteral orifice and a large Garceau went in without the slightest obstruction. This, of course, eliminated stricture, but not valve. I drained the left ureter repeatedly, every two or three days and washed it with various antiseptics, but was never able to relieve the patient of the infection or of her symptoms of malaise and intermittent fever. She would feel better after emptying the ureter of its contents, which was always from 6 to 9 ounces.

Repeated functional tests showed that the left kidney was better than the right. Sometimes they were both low and sometimes they were good, depending upon the amount of absorption the patient was getting. In other words, we were dealing with an infected retention in the left ureter with the kidney possessing excellent function, even better, as a general rule than the function of the other side, although the function of the other side was frequently normal and the urine always uninfected.

Showing no improvement under repeated drainage, something more radical had to be undertaken. My first impression was that the kidney would have to be removed since ureteral transplantation into the bladder with such a large flabby infected ureter would in all probability be inadvisable.

On two occasions, I slit the orifice with the scissors designed for the Brown-Burger cystoscope. And with a small incision, as one is able to make with this instrument, the patient showed some improvement and was able to empty the ureter at times down to 2 to 4 ounces. There was recontraction, however, and the condition assumed its previous relations. Because of this improvement from a slight incision of the uretero-vesical valve, I proposed to the patient that we make a much more extensive incision under an anesthetic. Under a whiff of gas, I passed a rather large pair of eye scissors, made especially with a long handle, by the side of the cystoscope and the ureteral orifice was cut for about $\frac{3}{8}$ inch through the scar tissue of the previous cuttings. The edges of this incision were quite rigid and we cut them away, leaving a gutter. Following this, there was a sudden gush of urine which clouded the field. Two no. 6 ureter catheters were then passed into the ureter and left in. An interesting thing is, that almost immediately after the patient was awake and the kidney began to secrete, there was intermittent, snappy secretion from this kidney. In other words, the ureter had its normal peristalsis.

There was no immediate trouble following the operation, but the patient had a great deal of bladder irritability for about two months. The symptoms were really out of proportion to the findings.

She was in Chicago and I advised her to see Dr. Kretschmer. This she did and Dr. Kretschmer's findings were as follows:

"Patient's left kidney function at the time was much better than the right. Infection in the left side, not in the right. A very large ureter, the size of a small gut with no dilatation of the renal pelvis. She had, at this time, a very stormy bladder." Dr. Kretschmer's opinion was, that the patient was in a state of semi-invalidism and had evidently received but little benefit from non-operative treatment and he felt that either a nephro-ureterectomy or an anastomosis would be necessary, most probably the former.

I saw the patient about two weeks after this and she was beginning to improve. At this time, her urine was perfectly clear and there was no retention in the ureter. There was still marked reaction around the left ureteral orifice. She gradually improved in strength and health. Bladder irritability showed a remarkable change and except for occasional flurries, gave her no discomfort. I have watched her at least every week since then. Have catheterized her left ureter repeatedly and, with one or two exceptions, when one ounce was found, there was no retention whatever. She has had repeated colds, and almost invariably following colds gets a recurrent infection in the ureter. This is usually evanescent.

Cystoscope has shown, since September, that the ureteral orifice is open and gaping and one is able to put a Garceau catheter and two other catheters in this opening.

A recent ureterographic study has disclosed some interesting phenomena. In spite of the fact that she has emptied her ureter for eight months, I can, at the present time, put 8 to 10 ounces of fluid in it without causing her pain and there is still an enormous dilatation. I was convinced that this would be so. I have studied the emptying process of this ureter by repeated radiographic examinations and tried to determine the manner in which it is excreted. After filling the ureter, plates were taken throughout its extent at different intervals.

At the end of five minutes, it is noted that the true pelvis is still completely filled, but the calyces contain practically nothing. The outline of the pelvis appears normal and tapers down to a normal point at the uretero-pelvic juncture in striking contrast to the picture taken when the ureter was full, in which case the whole upper ureter was broad. This, I take it to represent forcible muscle contraction of the upper ureter, wherby the ureteral walls approximate in the region of the upper normal physiological constriction. This would seem to indicate the preservation of great tonicity of the internal circular coat in the upper ureter. This may be the safety valve which has protected the pelvis against dilatation. It is in this region, where the peristalic waves have their greatest metabolic rate.

There is seen no fluid in the upper ureteral spindle, figure 4, but the lower ureter is still large and contains a great deal of fluid and shows an interesting condition at its lower end. One can see a fine line of fluid running from the ureter into the bladder. This line is less than $\frac{1}{8}$ inch in diameter and about the same length. It is possibly the remains of the intramural ureter. There is a certain amount of the material seen in the bladder at this time (plate 6), and the lower end of the ureter instead of being rounded, is angular, evidently from muscle effort.

At the end of fifteen minutes, after patient had been up and about, there is seen more bromide solution in the upper ureter than at the end of five minutes, yet none in the calyces of the kidney and the uretero-pelvic juncture does not come to a point, but the upper ureter is broad throughout and reaches almost to the fourth lumbar transverse process. There seems to be less in the lower ureter than at the end of five minutes, but no line of communication between these two, the mid-ureter is still empty (plates 1 and 4).

The explanation of this can be that there has been either a peristalsis, or a regurgitation from the ureter itself or from the bladder directly to the kidney pelvis. On filling the baldder, under great pressure, there is seen some material in the lower ureter, but none in the kidney pelvis.

Reversed peristalsis in the ureter has always been doubted, but we have seen calculi rapidly driven from the upper to the lower ureter, and since this patient was up and about, the picture taken in the semi-upright position, eliminating dependency, from the fact that there was no material in the pelvis after over filling the bladder, would seem to indicate that this process of secondary filling of the pelvis is in all probability due to a regurgitation in the ureter itself or possibly to retro-peristalsis. The lower ureter is still enormously distended up to the middle of the sacrum, at which location the upper part comes together at a point, again showing muscle contraction. At the end of one hour, there is still retention in the lower ureter.

We see, therefore, that this ureter, released of some of its tension at the vesical orifice, is able to keep itself empty under ordinary conditions. Yet when it is suddenly filled, its outline is the same as before the cutting of the orifice and it requires considerable time for the complete evacuation of its contents.

This patient was seen three days after this study was made and the ureter was entirely empty and urine was being ejaculated intermittently through the catheter. The renal function at this time showed 25 per cent from the left and 20 per cent from the right in thirty minutes.

The points of interest are: Enormously dilatated ureters without a corresponding dilatation of the renal pelvis—without evidence of a lower ureteral obstruction, except the possibility of a small intramural valve and without proportionate disturbances of renal function.

Marked improvement followed an extensive cystoscopic incision of the uretero-vesical valve.

Since Braasch and Draper showed that the uretero-vesical orifice could be incised without deleterous effects, this procedure has been employed for stricture and stones at the orifice. I have also found it valuable for stones in the lower ureter. On several occasions, I have had stones remain stationary for a long time in the lower end of the ureter well up from the bladder and showed no tendency to pass after intraureteral manipulation, to be promptly extruded after the incision of the orifice.

I believe the extensive incision of this valve for over a centimeter has worked an extraordinary benefit to the ureteral condition, described in this paper. There was regurgitation up this ureter following marked intravesical pressure. This condition had not been present previously.

Another very interesting feature was the persistence of peristalsis often such a protracted dilatation. A point of great interest was the refilling of the upper ureter after it had been empty, with the plate taken of the patient in an upright position in order to eliminate dependency. This may represent retroperistalsis or it may be a regurgitation from the ureter or bladder to the pelvis, but with the amount of pressure necessary to force the fluid into the ureter from the bladder and the pain and discomfort produced to the patient in so doing, speaks rather against this and for a reversal of the ureteral current.

There was found no sign of nerve lesion to explain its genesis. As a matter of fact, large ureteral dilatations are not proportionately common in diseases of the central nervous system.

Patient gave birth to a child with harelip. As you are well aware, embryological arrests in development are not uncommon. For example, harelip seems to be due to temporary arrest of a single process during the early part of the second month, followed by a wholly normal subsequent development.

Coloboma is a result of a similar series of events occurring at the same time. It seems quite possible that this type of ureter may belong to the category of temporary early arrests. If the ureter were to remain larger than normal until its muscular coats were formed, it would probably continue in the same relative proportion.

Another possibility is that the disturbances may have occurred in the fourth month at the time when the ureter normally forms enlargements. It may be also that there is sufficient musculature, particularly in the upper ureter to protect the renal pelvis against back pressure and the fact that the early pelvic bifurcation is surrounded by the blastimal cap may also have had a protective influence. On the other hand, it may be that there has been a persistence of the valves in the intramural part of the ureter.

The ureteral condition discussed in this paper impresses me as having a marked similarity to giant colon. You will remember that the origin of this condition of the bowel has created considerable discussion and at the present time has not a satisfactory explanation.

The three chief theories as to its genesis are, first, congenital defect in the development of the bowel itself; second, that it is due to some form of mechanical obstruction and that the colon dilatates in an effort to overcome this obstruction; third, that it is due to spasm of the circular muscles in the lower part of the intestine and the dilatation of the colon follows this spasm, just as dilatation of the esophagus follows cardio spasm.

Dr. Will Mayo, Dr. Finney and Dr. Dowd have contributed important articles on this subject. In discussing this subject with Dr. Walter Mills, he inclines to the belief that the normal recto-sigmoid sphincter exerts obstructive influence on the bowel, which is not possessed of its normal tonicity due in all probability to some condition of the bowel itself. It is a condition of the large bowel seldom going beyond the ileo-cecal valve. This coincides somewhat with my opinion as to the ureteral condition. That the wall of the ureter itself was probably, by birth, enormously enlarged with musculature, that is incompetent to empty this ureter, against what would be a normal physiological resistance at the uretero-vesical valve. It may be that the ureteropelvic orifice has a protective influence on the renal pelvis. At any rate, the pelvis has been completely spared.

The peculiar emptying of this ureter, in really a convulsive way, is also similar to the emptying of a giant colon. It is possible that there is an incoördination between the muscle of the ureteral wall and its sphincter and that the discordant waves of the ureter undergo fibrillation, finally to break with a heavy expulsion.

Finally the treatment offers a serious problem. Dilatations are entirely ineffective. Uretero-vesical anastomosis would in all probability be unsuccessful. Uretero-intestinal anastomosis would be out of the question and one would have to remove a kidney so normal as this. For this reason, if the simple method of incision of the uretero-vesical orifice is effective, we are very fortunate. In the female, it can be done effectively by special scissors put beside the cystoscope, but in the male, such a free incision with the delicate instruments for an operating cystoscope would be hard to perform.

GRAVE RENAL HEMATURIAS DUE TO BLOOD VESSEL CHANGES IN THE PAPILLAE WITH THE REPORT OF AN UNUSUAL CASE REQUIRING NEPHRECTOMY[1]

GRANVILLE MacGOWAN
Los Angeles

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In order to understand the diseases or injuries by which one or more of the renal papillae may be affected one has to bear in mind, the anatomical structure of the pyramids of Malpighi. The number of these pyramids is not definite, but there are from ten to twelve, at least. The number of the papillae does not always correspond with the number of the pyramids, for there are diverse types of the papillae—simple, bifoliated and trifoliated: the first representing, usually the ending of one; the second, of two adjacent; and the third, the three or more neighboring pyramids. Each papilla has a base and an apex; the base is continuous with the body of the pyramid, is firm and inserted closely to its neck is the terminal structure of the corresponding minor calyx; its apex is soft, smooth, round, and presents many fine orifices which are endings of the papillary ducts. The openings of these ducts, oval or slit like, together present a cribriform aspect, not at all unlike the nozzle of a sprinkling can, and function like one. The urine drips, oozes or spurts from the orifices as the urinary pressure in the glomerulae is stationary, diminishes or increases. Beyond the base of the papilla and extending to the base of the pyramid is a darker area, striated and presenting a series of rays, alternating, pale and colored, which consists of uriniferous tubules, intimately attached to each other, and lying in or surrounded by a capillary network of blood vessels, springing from the arteria rectae, and forming at the level of the duct endings, a kind of collar, surrounding each uriniferous duct. The plexus of finest veins empty directly into the venous arch at the base of the pyramids. The office of the renal papilla is readily surmised by its anatomical construction. It is the ultimate end of a complicated apparatus, designed for filtration and for the proper operation of the filter or for a system of drainage of any kind, the discharge pipes must be kept free and unobstructed. Any alteration, inflammatory or otherwise in the structure of the papilla, any increase in connective tissue or in degeneration of its blood vessel supply, or any infection of its structure will result in interference with its office as a filter. It is by means of the papillae, as a matter of fact, that the products, separated by the glandular tissue are evacuated from the body. How can a filter act, if its orifices are obstructed in anyway? The smallest of lesions at the point of discharge of the urinary tubules, must react upon the entire kidney, or at least upon that portion of the kidney, which finds its outlet in this particular papillae; congestion, active inflammation, increase in connective tissue, all tending to diminish the caliber of the collecting canals, and to reduce the area of the uriniferous ducts, will delay the urinary stream in the parts above and in the pyramids, producing a stasis with ultimate formation of cysts, and in the presence of infection from migrating colonies of bacteria coming through the blood stream—the formation of abscesses. The fibrosis may lead to true stricture of the papillary ducts in the cribriform area, and is at times accompanied by the deposit of inorganic salts in or between the uriniferous tubules or upon their eroded endings, forming microscopic stones, which, of course must increase the chronicity of the inflammatory process and lead to more hemorrhage. Add to these pathological incidents, hemorrhages from ulcerations due to necrotic changes following colonization of tubercle bacilli in the terminal blood vessels of the papillae or from the development of cancer in the cribiform area and we have many reasons in these obscure bleedings to spur us to diligence in arriving at a diagnosis, before irreparable destruction takes place. This is a matter which is accompanied by very great difficulties, which we recognize and yet whatever renders progress laborious, is not necessarily impossible, so the ultimate obtaining of a satisfactory diagnosis early should not be despaired of, because in the present century, such enormous advances have been made in the ability to accurately diagnose what we formerly considered obscure diseases of the bladder and kidneys, that the present problem of being able to deal with these papillary affections with the same degree of complete assurance of a reasonably correct diagnosis is very small as compared with the problems presented to us of the last generation, which we have so successfully solved with relation to the majority of surgical diseases of the kidney.

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[1] Read at the meeting of the American Urological Association, April, 1922.

Before taking up the subject of our case report, we wish to draw the direct attention of the members of our Association to the obscure causes of the presence of blood in the urine, due definitely to changes of the papillae in the kidney. The most common cause of hemorrhage from the papillae, I believe to be tuberculosis, which is not very difficult to understand, for tuberculosis of the kidney is a very common disease, which of itself is very natural in as much as the mass of humanity, at some time, during its existence is tuberculous. The kidney filters the greater part of the organic poisons, which circulate in the blood stream, whether these be developed within the body or are taken into it from the outside. As all of these poisons must pass out through the papillae, it is in the papillae that one would naturally look for localized infections more than in the parenchyma; and it is truly here that we find them. It is at the end reaches of the duct tubes that at the appearance of inflammatory hyperplasia or fibrosis a stasis of the primary urinary stream takes place. In detecting hemorrhage due to tuberculosis of the papillae, methods of diagnosis exist, which patiently applied are almost invaluable. Often even if but one papilla is infected and the lesion is small, we have frequent urination or dysuria; the presence of blood in the urine, either abundant or in microscopic quantities; the presence of tubercle bacilli, which in our experience can be found in, at least, ninety per cent of the cases, if sought for in the proper manner, the specimens being obtained sterile from the bladder by catheterization, received in a sterile receptacle and immediately centrifuged at a very high rate of speed, for a very long time—from a half hour to an hour, and then examined in the usual manner—or at a moderate rate of speed for ten minutes, the sediment withdrawn and the supernatant fluid then centrifuged at a speed of not less than 5000 revolutions per minute and its sediment stained. In addition, the pre-ulcerative changes in the mucosa and sub-mucosa about the mouth of the ureter on the diseased side, are virtually unmistakable when considered with the other symptoms.

Careful research into the condition of the other organs of the body, now and in the past, including the revelations of x-ray pictures will nearly always reveal the existence of active or suppressed tuberculous foci elsewhere.

CANCER OF THE PAPILLAE

In well defined cases of malignant diseases of the kidney in which the organ cannot be palpated, the diagnosis is reasonably confirmed by means of the filling deformities of the calyces, and the pelvis, in the pyelograms; but it is not very likely that in commencing cancer of any one papillary body, diagnosis would be possible by this means, and it is certainly not possible by any other means. The first symptoms and the only symptom is the bleeding.

Another disease of the renal papilla, which is accompanied by hemorrhage is calculous incrustation. There are two ways in which a deposit of lime salts may form upon a papilla. First, in the presence of a staphylococcus or streptococcus infection in a pyramid or in its calyx—the production of ammonia as a result of the splitting of the urea will furnish the occasion of a deposit of phosphatic debris. Second, if the urine be scant, surcharged with lime salts and there is some narrowing of the urinary ducts in the cribriform area by reason of previous inflammatory attacks, the slowing of the urinary rate may precipitate a deposit about the mouths of these ducts quite easily and upon this primary deposit, subsequent incrustations form. Along with the hemorrhage, occur the ordinary symptoms of nephritic colic, lumbar pain, running out along the distribution of the ilioinguinal and ilio-crural nerves, and nausea. Radiography will usually show shadow in the offending calyx. The treatment necessarily must be operative. Medical measures cannot be of any avail. In this connection I cannot pass without mentioning the remarkable report of Payne on the pathology of three cases of multiple papilitis, one in a man, and two in dogs, resulting from chronic inflammatory changes in the papilla, and accompanied by the formation of minute calculi between and in the uriniferous tubules, but chiefly outside of the ducts in close apposition to the dilated capillaries and surrounded by connective tissue, .in which there were ruptured varices on the free surfaces of the papilla. The beautiful sections show the presence of these microscopical stones, the origin of which is more difficult to explain than their effects. No mention is made of the chemical character of this sand; whether it was uratic or calcareous. The presence of stony deposits outside of the ducts almost necessarily suggests its origin as gouty, because gouty deposits may be laid down in connective tissue in any portion of the body, whereas the presence of deposits, phosphates or carbonates, in the interspaces between the tubules in the stroma is much more difficult to reasonably explain, particularly in the experimental cases of the two dogs. In Rosenow's experimental production of renal calculi in dogs, following the inoculation of certain streptococci in the pulp cavity of the teeth, in addition to the formation of gravel in the calyces in places, there was found to be a deposit of crystals in the collecting tubules in the presence of the stone producing streptococci. A stone in the kidney that is mobile, will have its symptoms very much influenced by rest, whereas calculous incrustations of a papilla, being stationary, the hemorrhage is made no better nor does it grow any worse either in repose or by movement. Two other affections of the papillae give rise to very grave hemorrhages, which sometimes result in either primary or secondary loss of life. Both of these are of blood vessel origin, due to defects in the vessels of supply or of drainage. The symptoms observed are the same in both cases; the chief of them is hematuria, which is commonly painless; its advent is, in my experience without any traceable cause. It is sometimes abundant, frequently intermittent. There may or may not be pain; if there is, it is of a colicky nature, and brought about in the presence of a high coagulation point of the blood, by the ureter filling with organized clots. Diagnosis has to be made by exclusion. That is, when in the absence of any of the usual causes of renal hemorrhages, as determined by local examination, microscopical observations of the urine, information acquired by the cystoscope and by radiography, we definitely determine the absence of tuberculosis, stone or malignant tumor, simple colon bacillus infection, obvious focal infections, acute or chronic interstitial nephritis, mineral poisoning, the absence of constitutional dyscrasia like scurvy or purpura, and the bleeding is present, the kidney function being good, as determined by its output of urea, we are obliged to consider the existence of angioma or varicosity of the papillae as the cause of the hemorrhage. The prognosis in these cases is always serious. While considerable intervals between the hemorrhages often occur, more frequently hemorrhages continue until they have exhausted the patient, or until the offending kidney is removed. In the question of pre-operative diagnosis, between these two conditions, we have to consider the presence elsewhere of varicosities or of angiomatous degenerations of the blood vessel supply, more commonly in the skin and about the rectum. If the patient has definite varicose veins of the lower extremities or of the hemorrhoidal spaces about the anus and has no telangiectasic degeneration in the skin or about the accessible mucus tracts, then we will be more likely to think of varix of the blood vessels of the papillae than of an angiomatous growth. In either case, the pre-operative diagnosis is only one of probability, not of certainty. Early in the century, this condition was brought to the attention of the surgical world by Fenwick of London, who published a series of cases upon grave intermittent hematuria in which the cause of the bleeding was held to be angioma of the papillae. Some of these were, and some were not convincing, but the work broke trail for subsequent investigation.

In 1909, Hugh Cabot in the American Journal of Medical Science for January, reported a similar case for which a nephrectomy was done by Morris Richardson in October, 1907. The specimen at gross examination showed nothing abnormal excepting two papillae in the lower pole, reddened and a little spongy. Microscopical sections showed that the small venules at the tip of each papilla were irregular and dilated to two or three times their normal size, and covered on their free surface with the finest possible film of connective tissue and a single layer of epithelial cells. Here and there these venules projected as knuckles above the surface; the lumen of the vessels was filled in many places with fine granular detritus and occasional red blood cells. The straight tubules of this region contained red blood cells but not higher than the base of the pyramids.

At the meeting of this society in June, 1909, stimulated by the report of Cabot, the writer put three cases of a similar nature on record but although they were published in Annals of Surgery for May, 1910, as well as in the 1909 Annual Transactions of this Society (pp. 234–236), this fact seems to have escaped the attention of all who have written upon the subject since, with the exception of Randall, Ballenger and Legueu. I presume, because I unfortunately could not present slides of the microscopic sections with the reports. In the first, the only microscopic change found was hyperplasia of the blood vessels of the papillae; in the second, the specimen was laid upon a gauze sponge during the operation and a careless nurse threw it in with the other sponges, and it was lost. In the third, at the time of operation, as the hemisected kidney lay in my hands, on two of the papillae there was a covering of blood vessels like unto red moss, oozing blood continuously, like water seeping through cement surfaces of a tunnel, back of which lies a spring. Microscopic sections showed dilated blood vessels with thin walls. In all three cases, contrary to the experience of Fenwick, the diseased papillae were found in the upper pole. I was able to observe them by a free nephrotomy, made by splitting the kidney and its pelvis from pole to pole with a long wide, very sharp and thin bladed section knife. In each case, the diseased papilla was removed by a wedged shaped incision into the pyramid, large enough to remove all of the obviously diseased tissue. The sides were then united by means of small cat-gut carried in fine round pointed needles, in the first two cases successfully, but in the third, I was obliged to make use of a fine electric cautery to sear the base, as the stitches would not hold.

There was a fourth case of this nature, operated upon by me, in March, 1912; this was treated in a similar manner, but the results were not so auspicious. The kidney after hemisection was united with matrass sutures of twenty-day chromic cat-gut, no. 1. This man, one of my dear friends, bled to death, from a secondary hemorrhage, caused by the absorption of this twenty-day gut, on the fifth day. We are unable to give full particulars of this case, as when this report was made up, it was found that the entire case history had disappeared from our files, having been lost, it is presumed in moving a few years ago.

Treatment by medical measures is usually futile, but admitting this, one should not refuse to employ such simple measures as have been shown to be followed, at least for a time, by cessation of the hemorrhage, like an injection of blood serum intravenous or intramuscular, or of whole blood in the form of a transfusion, the instillation into the pelvis of the kidney of sterile solutions of adrenalin chloride or of solutions of silver nitrate, or the free use of cotarnine hydro-chlorate, internally. Cessation of the hemorrhage has been known to follow the passage of a ureteral catheter or the taking of pyelograms, but the eventual treatment of these exhausting unilateral renal hemorhages, no matter what the cause is by operative interference by nephrectomy or nephrotomy. The only reasonable method for a nephrotomy is one in which the entire kidney, if it can be easily mobilized, is bisected, through the outside of Brodel's line, so as to obtain an exposure of all of the calyces, the blood vessels in the meantime being temporarily ligated at the hilum. If a calyx is found, in which the mucosa reflected over the papillae shows signs of hemorrhage into the tissues, or in which there is a clot attached to the papilla, or if when the pressure on the blood vessels is slightly reduced, bleeds of its own initiative without injury to its mucous membrane, or shows unquestionably the presence of an angiomatous or varicose network, you can be very sure that the diseased point has been found and it may be removed by one of three methods, all of which I have used at different times: First, It may be excised with a thin bladed, very sharp cataract knife, and its sides brought together with fine cat-gut ligatures, using a fine round pointed needle. Second, it may be destroyed with the electric cautery. Third, it may be removed with the curette.

Fenwick recommended, for the treatment of varices, the rough destruction of the renal venous arch at the base of the pyramid, by using the end of the finger, or some blunt instrument introduced for that purpose. This has never appealed to me as a surgical measure, because of its inaccuracy and uncertainty. While treatment of such conditions in a conservative manner, has been successful with us, in the presence of a definite blood vessel change, which was perceptible and unquestionable, and confined to one or two papillae, if the companion kidney is a potent one, as ascertained by its dye and urea output, the blood urea and blood creatinin indices, we recommend others to do a nephrectomy, on account of the lamentable experience of the last case in which we used this method.

I now wish to report another case of unilateral exhausting and painful hematuria, where the kidney was removed, and in which the lesions were very similar to those reported as renal papillary varix, following chronic inflammation of the pyramids, which presents some unique circumstances and is well worthy of being recorded.

Mr. L. E. B., age sixty-seven, a theatrical manager, and impressario. He was taken ill on March 18, 1921, with intense pain in the right side of the abdomen, colicky in nature, with nausea, slight temperature and hematuria. He gave a history of having been treated for some prostatic trouble in New York in 1907. In 1910, again while on a visit to that city, he had a cold and for about two weeks he had blood in his urine. At the time he came to me his urine contained many red blood cells, a few hyaline casts and a small amount of albumen.

Blood count. March 2, 1921: Polymorphonuclear 83 per cent, lymphocytes 9 per cent, white blood cells 13,500, red blood cells 4,500,000. Urine obtained sterile from the bladder for microscopical examination for bacteria. No tubercle bacilli or other organisms were found.

March 26: Cystoscopic examination with ureteral catheterization. The bladder was free from lesions of any kind. The right ureteral orifice was stained with blood and slightly eroded.

Functional test with phenol sulphone 'phthalein.

Right kidney. Dye appeared in 9½ minutes; 9 per cent for first half hour, microscopical examination of this urine showed red blood cells three plus, pus two plus; no tubercle bacilli found.

Left kidney. Dye appeared in 5 minutes; 24 per cent for first half hour; microscopical examination showed a few red blood cells and a few small epithelial cells; no tubercle bacilli or other organisms were found.

Blood creatinin 1.18 mgm. per 100 cc. of blood.

Physical findings in this case were then a right sided renal colic. The right ureteral meatus was found to differ slightly from its fellow in a diseased way. There was a lessened amount of kidney function on the right side, as shown in the elimination of the dye, and also in the amount of sodium chloride; the presence of considerable blood and a small amount of pus in the catheterized specimens from the right side, the continuous and painless hematuria together with the absence of tubercle bacilli or other organisms pointed strongly to the diagnosis of idiopathic hematuria, which commonly means either varicosity of one or more of the papillary bodies or an angiomatous condition requiring a nephrectomy.

April 7, 1921—Nephrectomy. The kidney was a small one, not thoracic, closely adherent at the upper pole, and with anomalous arteries both at the upper and lower poles, difficult to deliver because of these factors. After its removal, when the pelvis was cut into, I found that the two uppermost papillae appeared to be angiomatous. There was a hemorrhagic patch in and beneath the mucosa of the pelvis about the size of a silver quarter, which appeared to the eye to be partially recent and partially old. There was no evidence of malignancy, or tuberculous degeneration.

His recovery was a very stormy one, complicated by arthritis and by gaseous distensions of the bowels due to colitis, factors which interfered very greatly with his nutrition and rest and very markedly with the healing of his wound, so that he was obliged to remain in the hospital until the first of June. Examination of the kidney was made by the Laboratory of Brem, Zeiler and Hammack with the following report:

Kidney measures 11 x 5 x 3.5 cm. Surface is smooth, capsule strips readily leaving smooth surface. Pelvis of kidney slightly enlarged. In the mucosa is a hemorrhagic area 1.5 cm. in diameter. In one calyx the mucosa is hemorrhagic as is also the tip of the papilla in this calyx. One other papilla is extremely red. The cortex is light brown, measures 6 to 9 mm. in thickness; pyramids are pink. Microscopic: Kidney cortex contains numerous completely fibrosed glomeruli. Other glomeruli have a narrow ring of fibrous tissue about the capsule, others show proliferation of the lining of the capsule which in some is a hyaline eosin staining substance evidently albuminous. The tubules are less affected but a few show desquamation and necrosis of a few cells. Stain for fat shows fat globules in many. Many tubules contain hyaline or brownish granular material. Between tubules in a few

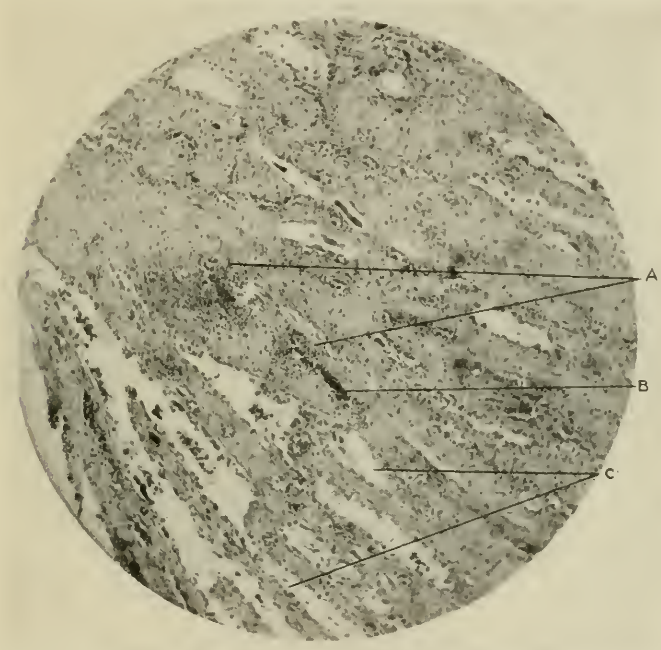

Fig. 1. *A*, Hemorrhagic Areas; *B*, Distended Bloodvessel; *C*, Tubules

areas is slight round cell infiltration and a few fairly large foci of round cells are found. Section of the hemorrhagic papilla shows an old partially organized hemorrhagic area as well as recent diffuse hemorrhage, new formed connective tissue with replacement of tubules, round cell and eosinophile infiltration. Section of hemorrhagic area in the pelvis shows in addition to the recent diffuse hemorrhage old phagocytized pigment. There is well marked small round cell and eosinophile infiltration.

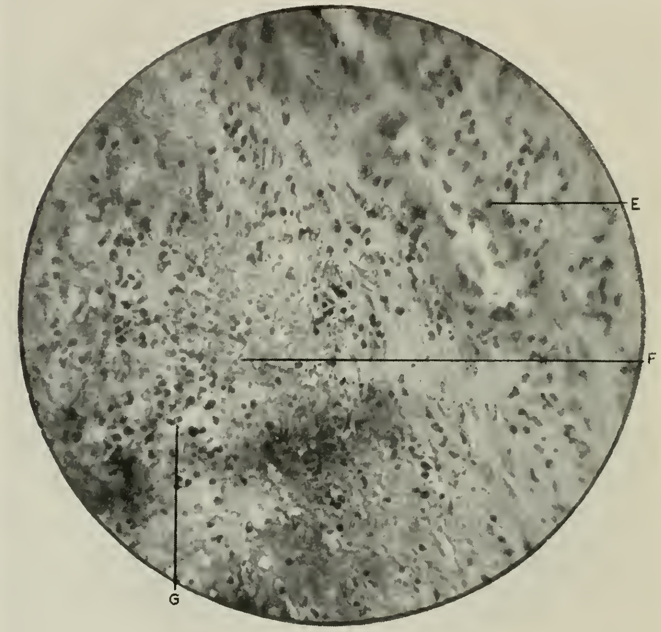

Fig. 2. *E*, Tubule with Beginning Necrosis of Epithelium; *F*, Large Hemorrhagic Area; *G*, Inflammatory Infiltration, Reactive

Diagnosis. Chronic diffuse nephritis; chronic hemorrhagic papillitis; thronic pyelitis.

At the time of making this report, he is conducting his business with efficiency and comfort; there is no albumin or blood present in the urine; his blood creatinin and blood sugar are normal.

REFERENCES

Allen: Bilateral haematuria cured by injection of whole blood. American Journal of Surg., December, 1913, 465.

Ballenger: Journal Records of Medicine, Atlanta, June. 1912.

Barrenger: Injection of blood serum for unilateral renal haemorrhage. Jour. Amer. Med. Assoc., October 26, 1912, 1538.

Braasch: Jour. Amer. Med. Assoc., 1913.

Cabot, Hugh: Amer. Jour. Med. Sci., January, 1909.

Chute: The significance of haematuria. Boston Jour. Surg., June 17, 1920.

Fenwick: Meatoscopy in obscure diseases of the kidney. J. and A. Churchill. London, 1903.

Grandjean: Travaux Annuels de L'Hopital d'Urologie, Paris, 1919, 198.

Hyman: Renal haematuria. Amer. Jour. Surg., December, 1920, 312.

Legeu: Traite Chirurgical d'Urologie, Paris. 1910, 195.

Legeu et Malherbe: Des Hematuries essentielles. Rapp a la quatriemesession de l'ass franc d'Urologie, 1899, 7.

Levy: Essential haematuria. Surg. Gyn. and Obstet., January, 1922, 322

MacGowan: Haematuria with report of cases. Cal. State Jour. Med., 1908. Medical News, December 7, 1901. Annual Trans. A. U. Assn., 1909 238–44. Annals Surgery April 1910.

Nelken: Essential haematuria. Amer. Jour. Urol., September, 1912.

Payne: Unilateral haematuria associated with fibrosis and multiple calculi of the renal papillae. Surg. Gyn. and Obstet., July, 1916, 76.

Payne and McNider: Surg. Gyn. and Obstet., 1913, Jour. Amer. Med. Assoc.

Pilcher: Renal varix. Annals of Surgery 1909, xlix, 652.

Quimby, W. C.: The pathology of the renal pelvis in two cases, showing haematuria of the so-called essential type. Jour. Urol., June, 1920.

Randall, Alexander: Etiology of unilaterial haematuria, Jour. Amer. Med. Assoc., January 4, 1913.

Spitzer: Continous painless renal hemorrhage and its treatment. Jour. Amer. Med. Assoc. December 12, 1914.

BONE SUPPURATION THE BASIC CAUSE OF RENAL CALCULUS IN TWENTY CASES FOLLOWING WAR-WOUNDS[1]

H. ERNEST PAUL

Toronto, Canada

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It is very doubtful if any definite conclusions could be drawn from a review of the very extensive literature dealing with the etiology of stone in the kidney, and such a review is obviously beyond the scope of this article. To illustrate the trend of medical opinion, however, the citation of a few representative opinions on this etiology is considered justifiable.

In 1821, Prout of London gave as the principal causes of lithic acid in the urine, simple errors of diet; unusual and unnatural exercises of body and mind, particularly after eating; the want of proper exercise at all times, and debilitating circumstances. Seventy years later, Legueu of Paris gave as the principal etiological factors, sedentary occupations and hereditary predisposition, at the same time concluding, from a review of a considerable number of cases, that renal calculus occurred more often in the male and was most prevalent in the fourth decade of life.

In 1909, Schade, after extensive experimental and clinical observation, concluded that irreversible colloids, the commonest example of which was fibrin, are necessary for the formation of calculi and was of the opinion that fibrinuria in slight degree occurred more often than was commonly thought.

In 1910, Sir Almroth Wright suggested that a search for a bacterial cause be made in every case of urinary calculus. He, later in the same year, reported 4 personal cases.

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[1] Read at the meeting of the American Urological Association, April, 1922.

In 1913, Ohlmacher of Detroit, writing from the point of view of one doing special practice devoted to therapeutic immunization with bacterial vaccines as directed to infections generally, states that the concurrence of bacteriuria and urinary calculi has long been known, and draws the following conclusions:

> (1) The routine bacteriologic analysis of all cases of renal calculus and the associated pyuria and bacteriuria, are emphasized.
>
> (2) Therapeutic immunization with autogenous bacterial vaccines should be attempted in non-operative cases of calculus pyuria and bacteriuria for the relief of bladder irritability and impaired general health, and in cases in which there has been operation, when the symptoms persist unduly.

In 1918, Hugh Cabot in Modern Urology, discussing the etiology of renal calculus, concludes as follows:

> Supersaturated urine is secreted by the kidney under certain conditions which are at present unknown. In this supersaturated urine, crystallization occurs. These crystals, under certain conditions of retention, are held in the urinary tract for a time sufficiently long to enable them to grow to a size which constitutes a true concretion or calculus. Infection is a factor only insofar as it gives rise to conditions favoring retention and in that it affects the chemical composition of the stone.

In 1920, C. H. Mayo regards the infection theory of the origin of kidney stones as the only tenable one, and compares the development of stone in the kidney to the development of the shells of fresh and salt water mollusks which are built up by the bacteria feeding on the pabulum of the exuded mucoid material of the mollusk. If these bacteria become misplaced within the body of the mollusks, a pearl or slug develops as a result of such misplacement. He concludes.

> Stone formation is evidently the result of the combination of two types of bacteria; the first creates an infarction with minute necrosis causing mucoid exudate; the second factor is the elimination, at the same time, of the stone forming bacteria that they may come in contact with the mucoid material. If the stone originates in the cortex of the

kidney, its growth will be slow, but if it originates in the calyces or pelvis, growth may be much more rapid because of the ease with which its chemical material is secured.

Bone suppuration, or osteomyelitis, is described by Stengel and Fox as an infective disease resulting from hematogenous infection in the course of various diseases, from local infections, in cases of traumatism (fracture, amputation) or from periostitis. Various microörganisms, including staphylococci, streptococci, typhoid bacilli and the Bacillus coli communis, have been recovered from the blood.

References, or case reports, pointing to any special relationship between osteomyelitis and renal calculi are very few in the literature of either disease. Le Fur, in the discussion of Mayet's article, reports a case as follows: "We recall a case of a young fellow of twenty, who, following injury to the marrow (Moelle) by a bullet, having brought on a vesical retention immediately treated by cystotomy, presented, without infection, a bilateral renal lithiasis . . . . which I successfully operated."

Mayet's case reported in the above mentioned article, was a boy of seven years, immobilized for Potts' disease, in whom an abscess, which developed in the left iliac fossa, was repeatedly aspirated and injected. Four years after the abscess disappeared, hematuria developed and radiography showed, beyond doubt, the presence of a calculus in each kidney. The author is inclined to attribute these calculi as being secondary to a renal tuberculosis, though admitting that the inaction and the excess of phosphates ingested, quite possibly facilitated the production of the renal calculi.

In the discussion of this case, Cathelin did not believe that the immobilization or the ingestion of lime phosphate had very much to do with it; he thinks there were bacilli in the urine.

Pasteau, in the same discussion, says "It seems that there are cases of injured who have wounds of the marrow. . . . . Infection is the rule in these cases at the end of a certain length of time, and death comes on by renal infection and the formaion of secondary calculi."

Many cases are, no doubt, to be found in the literature in which renal calculi are associated with, or follow, bone suppuration or injury, but are not reported with special reference to the etiology. For instance, Hugh Cabot in 1910, among representative cases given to illustrate the operative technique, reports the following:

> A man, aged thirty-four suffered a severe crushing accident, involving the left hip, from which he recovered with considerable stiffness and some shortening of the leg. About a year after the accident, he passed a stone from his bladder, which troubled him only in its passage through the urethra. Three years later, renal colic and hematuria drove him to the hospital. Stone in the left ureter was shown by X-ray, and removed by proper incision. Recovery was uneventful.

Rosenow and Meisser in a recent article report the production of calculi in 5 out of 6 healthy dogs by sealing a culture of streptococcus, repeatedly isolated from the urine of a case of nephrolithiasis, into the teeth of the dog.

They state:

> The evidence of infection of the urinary tract, and the lesions in the kidney were slight except where obstruction in the ureter had occurred from impacted stone.
>
> The same streptococcus was isolated from the kidneys, from some of the stones, and from the teeth of the dogs, and its elective affinity for the medulla of the kidney in rabbits, on intravenous injection, was demonstrated; it was found in the lesions of the collecting tubules where crystallization and stone formation were beginning.

As all personal cases here reported occurred in ex-soldiers, it may be asked: Are men on active service for several years, predisposed to the development of renal calculi? No statistics are available to enable one to give a definite answer to such a query.

The frequency of calculi in the urinary tract in the French army, has been pointed out by Rochet and Boulouneix, as well as by F. Cathelin, the first named surgeons having seen as many as 42 cases, the latter, with his colleagues, having operated 6 cases of stone in the kidney, and seen a dozen others. All of these cases, however, occurred in men of middle age and no bone lesions are mentioned, and, aside from the fatiguing life in the field, no specific mention is made to an etiological factor.

Herewith are given short synopses of 20 cases of nephrolithiasis which have come under my observation during the past three years at the hospitals of the Department of Soldiers' Civil Reëstablishment situated in Toronto.

Where phenolsulphonephthalein or indigo-carmine was used as a test of kidney function, these drugs were always administered intravenously.

All the laboratory work, in connection with these cases, was done under the personal supervision of Dr. G. W. Lougheed.

Case 1. B. C., aged twenty-three, musician. First examined April 22, 1919.

History. April 24, 1915, shrapnel wound of back, laying bare portions of second and third lumbar vertebrae, accompanied by a temporary paraplegia, making catheterization necessary for about two weeks. Suppuration of wound persistent, requiring five months to heal completely. In December, 1918, three years and eight months after he was wounded, had aching pain in left loin, with occasional nocturnal frequency. February 2, 1919, first typical attack of left renal colic. April 20, 1919, bladder showed mild infection with B. coli and staphylococci. Radiograph showed a calculus the size of a small marble in the left kidney pelvis and a smaller one in the lower calyx. 'Phthalein excretion very little impaired on the left side. Total 'phthalein 42 per cent. May 1, 1919, pyelotomy and two calculi removed; recovery uneventful.

Case 2. S. P., aged twenty-two, blacksmith. First examined June 16, 1919.

History. August 15, 1917, multiple shrapnel wounds both legs and back, with compound fracture of right femur. At the same time he was taken prisoner-of-war. Prolonged suppuration of wounds which healed completely in September, 1918. In January, 1918, five months after being wounded, and while still a prisoner-of-war, had his first renal colic. Free of further attacks until June, 1919, at which time he was found to have 2 small calculi in the right ureter, 2 inches from the bladder. His urine showed a moderate infection. 'Phthalein excretion slightly impaired. October 2, 1919, 2 small calculi removed from lower end of the right ureter. Recovery uneventful.

In December, 1920, recurrence of renal colic. Radiography failed to show a calculus, but ureteral catheter was obstructed about 2½ inches from ureteral orifice. The right ureter was dilated to admit a no. 9 F. catheter, and, three days later, patient passed 2 small oxalate stones.

Case 3. W. R. B., aged thirty-one, factory manager. First examined in October, 1919.

History. In August, 1918, wounded by shrapnel which penetrated the chest, with comminuted fracture of two ribs. Considerable suppuration occurred and wound healed in nine weeks. For two months previous to being wounded, suffered with furuncles of the trunk and neck. In July, 1919, one year after being wounded, developed a typical attack or right renal colic, with pronounced pyuria. Frequent similar attacks until October. On October 3, 1919, a pyelogram showed a large pyonephrotic kidney, with a calculus the size of a large cherry in the lower calyx. Renal function of the right kidney was much impaired. November 11, 1919, this pyonephrotic right kidney, containing a whitish oxalate calculus the size of a walnut in the lower calyx, was removed under ether anesthesia. The infecting organism was the Staphylococcus aureus. Recovery uneventful. On February 18, 1920, total 'phthalein excreted in one hour was 48 per cent.

Case 4. N. R. J., aged twenty-seven, baker. First examined October 1, 1919.

History. In November, 1917, received wound causing a compound comminuted fracture in the middle third of the left femur; in bed, with drainage, etc., until March, 1918. In January, 1919, a small sequestrum was removed from left thigh. Wound healed in two weeks. June 10, 1919, nineteen months after he was wounded, had acute abdominal attack and appendix removed; no pathological report on the appendix available. In August, 1919, another similar attack of abdominal pain, but with some urinary disturbance: urine contained a few pus-cells and a few red blood cells. Radiograph failed to show any shadow suspicious of calculus. October 1, 1919, patient first seen when he was in a typical attack of right renal colic; temperature 103°; pulse 110; right kidney palpable. On cystoscopy, a calculus was seen slightly protruding from the right ureteral orifice into the bladder, and was first displaced from the ureteral orifice, pulled part way into the eye of an operating cystoscope and removed with the instrument. This calculus was of rough irregular shape (mulberry type), 1.5 cm. long by 1 cm. in diameter at its largest part. Two days later, no other calculi could be detected by radiography. Six months later, pyuria had disappeared and he had gained 14 pounds in weight. 'Phthalein excretion, normal.

Case 5. J. C., aged twenty-seven, clerk. First examined February 6, 1920.

History. October 30, 1917, multiple shrapnel wounds of right leg necessitating amputation 7 inches from great trochanter; prolonged suppuration in stump. In October, 1918, one year after being wounded, when first upon crutches, had hematuria without pain. In November, 1918, had right renal colic lasting three days. Had several attacks which were attributed to the gastro-intestinal tract. In June, 1919 radiograph showed a small stone in lower right ureter, which was passed, per urethram, three weeks later. No further trouble until August, 1920, when radiograph showed a definite calculus, low in the left kidney pelvis. Only slight impairment in function of the left kidney. Total 'phthalein excretion, 53 per cent. Urine showed no pus-cells or organisms by microscope. March 21, 1921, a dark-colored, irregularly shaped, mulberry calculus, the size of an almond, was removed from the uretero-pelvic junction by incision of a much dilated left kidney pelvis. Recovery was uneventful.

Case 6. H. C., aged twenty-seven, clerk. First examined April 6, 1920.

History. In June, 1916, shrapnel wound of right thigh, fracturing the great trochanter, with symptoms of shell-shock. Wound healed in five weeks. In January, 1920, three and one-half years after being wounded he had first attack of right renal colic, with quite free hematuria. Several attacks between January and April, 1920, when pain in right loin was more persistent but less severe. Urine showed a mild infection. On April 10, 1920, following cystoscopy and double catheterization, patient became quite ill, with temperature 102° to 105°F. X-ray negative for calculus, and guinea pig inoculation negative for tuberculosis. Patient to the country for summer but did not improve. October 12, 1920, ureteral catheter was obstructed about 2 inches from ureteral orifice, and urine still showed red and white blood cells. January 6, 1921, urine still showed blood. Weight, 97 pounds. January 14, 1921, X-ray, with opaque catheter in right ureter, showed a small shadow touching the catheter, 1 inch below the sacro-iliac synchondrosis. From February 17 to May 4, 1921, the right ureter was dilated to admit a no. 11 F. bougie. Patient still suffered more or less reaction after each cystoscopy. On May 23, 1921, a whitish, smooth calculus, the size of a pea, was passed per urethram. November, 1921, no further trouble, and radiologist reported kidneys and ureters free of calculi.

Case 7. A. D. A., aged 30, accountant. First examined June 9, 1920.

History. September 27, 1918, shrapnel wounds of right thigh, right hand and face; right leg amputated next day, 5 inches from great trochanter. Was catheterized for five days after amputation. Stump healed March 3, 1919. November 6, 1919, fourteen months after he was wounded, had first attack of abdominal pain which was treated as a gastro-intestinal attack. Similar, but more severe, attacks every two or three weeks until June, 1920, when pain was definitely located in the left loin and was typically renal. June 9, 1920, bladder urine showed moderate infection. Cystoscopy revealed a distinctly bloody swirl of urine from the left ureter. No pus or microörganisms were found in the left kidney urine; culture was not done. Radiograph showed a calculus the size of a cherry in the lower part of the left kidney-pelvis. Total 'phthalein, 48 per cent. Left kidney function only slightly impaired. June 21, 1920, a dark-colored mulberry calculus, the size of a hickory nut, was removed by pyelotomy. Recovery uneventful.

Case 8. W. J. N., aged thirty-seven, farmer. First examined October 10, 1920.

History. In August, 1917, shrapnel wound penetrating right chest, with temporary paraplegia, right hemothorax and, later, a phlebitis of right femoral vein. January 1, 1918, five months after being wounded, had first right renal colic. February 1, 1918, X-ray showed four calculi in right kidney. Urine contained much pus. February 7, 1918, nephrotomy attempted but not completed because of patient's poor condition. September 5, 1918, 5 calculi removed by a nephrotomy; patient improved slowly and pyuria persisted. In February, 1920, had first left renal colic. Repeated attacks until May 29, 1920, when calculus the size of a marble was removed by pyelotomy. Recovery slow but uneventful. August 16, 1920, on lifting a heavy object, took suddenly ill and developed an abscess at lower end of scar in right loin. Abscess opened several times, but sinus persisted, accompanied by low grade sepsis. In December, 1920, came to my service. Patient very anemic and had sepsis of low grade, sinus in right loin, extending about 2 inches below the crest of the ilium. Urine contained pus and few red blood cells 'Phthalein excretion, left kidney, 30 per cent. Total 'phthalein excretion, 40 per cent. Non-protein nitrogen was 40 mgm. per 100 cc. of blood. Radiograph showed a calculus, the size of a small bird's egg, in middle calyx of right kidney. A calculus, the size and shape of an almond, was found, protruding from cortex, about the middle of the external surface of the right kidney. This was removed, bleeding controlled by mattress sutures, the infiltrated fatty capsule cleaned out and provision made for free drainage of the perirenal space. Convalescence was stormy for first week. Recovery uneventful.

Case 9. N. R., aged twenty-nine, laborer. First examined December 12, 1920.

History. April 18, 1918, shrapnel wounds of right shoulder, right leg and back. Wounds were excised, and healed with moderate suppuation in six weeks. In May, 1919, nearly one year after being wounded, had a mild attack of left renal colic, followed by persistent aching pain in left loin, with some urinary disturbance. December 12, 1920, radiograph showed a small calculus in left kidney pelvis, and a small piece of metal in the muscles of the back at the level of the upper pole of left kidney. The bladder and left kidney urine showed a few pus cells. Red blood cells persisted in the bladder urine. Function of left kidney very slightly impaired, by 'phthalein test. Total 'phthalein, 56 per cent. January 27, 1921, a branched, dark-colored, mulberry calculus, the size of a pecan-nut, was removed from the left kidney pelvis by pyelotomy. February 9, 1921, X-ray showed the piece of metal in same position, but patient was free from symptoms.

Case 10. W. R. L., aged twenty-five trainman. First examined December 15, 1920.

History. In April, 1916, multiple shrapnel wounds of right thigh, with prolonged suppuration. Wounds not healed until April, 1917. During 1918 to 1919, pus and sequestra removed from right thigh on three occasions. In February, 1920, a right perinephritic abscess was drained by a small incision. Radiograph at this time showed no shadows suspicious of calculus. In August, 1920, three years and four months after being wounded, suffered with right renal colic for the first time, repeated attacks becoming more severe until December 10, 1920, when radiograph showed a stone the size of a lima bean in the lower pole of the right kidney. Urine showed only a few pus cells, but abundant cocci and bacilli. Function of right kidney markedly impaired. December 31, 1920, a pyonephrotic kidney, having a calculus the size of an almond in the cortex, was removed. Recovery uneventful. No return of symptoms nine months later.

Case 11. A. C., aged thirty-four, machinist. First examined December 15, 1920.

History. September 30, 1918, shrapnel wound of right knee-joint; this was drained. Streptococci recovered from wound on October 10, 1920, and, in November, 1920, the patella was removed and joint cleaned out with a view to obtaining ankylosis. Recovery uneventful. In September, 1920, two years after being wounded, first renal colic, with repeated attacks until December, when radiograph was first made and no shadow suspicious of stone was seen. Bladder urine showed moderate infection. December 15, 1920, cystoscopy revealed a calculus the size and shape of a small bean protruding from the right ureteral orifice. This was easily displaced by the instrument and was removed by forceps through the cystoscope. February 1, 1921, patient quite fit and a radiograph showed no shadows suspicious of calculi.

Case 12. H. L. B., aged thirty-three, clerk. First examined January 3, 1921.

History. March 31, 1917, multiple shrapnel wounds, right ankle, necessitating amputation 6 inches above the ankle. April 19, secondary hemorrhage and re-amputation 3 inches below the knee; a few days later, another amputation 4 inches above the knee. In November, 1917, another amputation was necessary before fitting his artificial limb. In December, 1918, nine months after being wounded, when first getting about on crutches, first noticed a dull pain in right loin, with moderate hematuria. In June, 1918, radiologist reported a small calculus in lower pole of right kidney. January 2, 1921, repeated severe attacks drove him to hospital when his bladder urine and urine from the right kidney showed a marked staphylococcus infection, the urine from the left kidney proving sterile on culture. Function of the right kidney only slightly impaired, and total 'phthalein 52 per cent. Radiograph showed a calculus the size of a walnut in the lower calyx of the right kidney. January 18, 1921, under gas oxygen, ether anesthesia, an irregularly oval, mulberry calculus, the size of a lima bean, was removed from the calyx, with some difficulty. Had a stormy convalescence for two weeks after operation. A small secondary hemorrhage on seventh day, and Staphylococcus aureus recovered from the wound. Recovery otherwise uneventful.

Case 13. R. N. B., aged twenty-four, electrician. First examined January 25, 1921.

History. August 13, 1917, extensive shrapnel wound of right thigh. Not reached by stretcher bearers for five days. A very serious infection, and amputation through middle third of thigh on December 13, 1917, followed by several operations for drainage. Stump not completely healed until June, 1920. January 23, 1921, three years and five months after being wounded, had first signs of renal colic. January 25, a radiogram with opaque catheter in ureter showed a calculus the size of a small bean in the right ureter, 2½ inches from the ureteral orifice. Urine showed mild infection of the bladder and both pelves with staphylococci and colon bacilli. Total 'phthalein, normal. The right ureter was gradually dilated to admit a no. 11 French bougie, and, on February 14, 1921, the patient suffered a very severe attack of right renal colic. On February 16, a smooth, whitish calculus, the size of a small bean, was removed from the bladder through the cystoscope. Recovery was uneventful and no recurrence of symptoms six months later.

Case 14. G. F., aged twenty-five, farmer. First examined February 22, 1921.

History. July 16, 1918, penetrating shrapnel wound of right lung. Wound discharged pus freely for one month. Hemoptysis continued two months. In November, 1920, two years and four months after being wounded, had his first renal colic on left side. No further attacks, but persistent aching pain in left loin. February 22, 1921, a very severe left renal colic brought him to hospital. March 1, 1921, urine from bladder and left kidney markedly infected. Radiography showed 5 small calculi of varying sizes scattered throughout the left kidney calyces and pelvis, and 6 calculi of about the same sizes in right kidney area. Indigo-carmine, intravenously, appeared strongly from the left kidney in eight minutes, and only a weak tinge from the right in fourteen minutes. March 12, 1920, non-protein nitrogen was 38 mgm. per 100 cc. of blood. Total 'phthalein, 38 per cent. It was decided to operate the right kidney first, and, on March 30, a large pyonephrotic kidney, containing 9 calculi, was removed. Recovery uneventful. May 26, non-protein nitrogen, 31 mgm. per 100 cc. of blood. Total 'phthalein, 34 per cent. No further left renal colic until June 15. From June 15, patient had frequent attacks of left colic, and was going down hill. June 30, under gas oxygen morphia anesthetic, 2 larger calculi were removed by pyelotomy, and the ureter shown by a bougie to be free from calculi. The incision in the pelvis was not sutured because of the patient's poor condition. Recovery was uneventful and patient left for his home in Scotland on August 15, 1921.

Case 15. I. R. J., aged thirty-two, motorman. First examined June 3, 1921.

History. September 26, 1918, a shrapnel wound of the left forearm, denuding the radius; wound excised, and through and through drainage established. Wound completely healed in two months. November 26, 1918, while convalescing, contracted influenza and in hospital until June 28, 1919. In June, 1919, noticed a sharp pain across the back, and, apparently on a chemical examination of the urine, his ailment was diagnosed nephritis. He continued treatment irregularly for nephritis until January, 1921, when he was discharged as greatly improved. In April, 1921, complained of dull aching pain, localizing in the right loin. May 27, 1921, twenty months after being wounded, and eighteen months after his influenza infection, patient had first right renal colic with hematuria. June 6, 1921, cystoscopy showed distinct hematuria from right ureter. Very slight impairment of kidney function, by phthalein test. Radiograph showed four very small shadows apparently in the cortex of the right kidney, and a calculus, the size of a large pea, in the right ureter at junction of the middle and lower third. Bladder urine and urine from right kidney showed a moderate infection. Urine from left kidney showed only a scanty growth of Staphylococcus albus on culture. June 10, a no. 9 F. ureteral catheter was introduced and left in place for eighteen hours. June 14, patient passed a smooth, greyish stone the size of a pea. Symptomatic recovery uneventful.

Case 16. A. E. W., aged thirty-one, jeweller. First examined June 13, 1921.

History. December 22, 1917, multiple shrapnel wounds of the back, buttocks and right knee-joint. Two weeks later, right leg amputated 3½ inches from the great trochanter; stump healed in three months. Re-amputation in July, 1919. In May, 1918, patient was told he had sand in his urine, but had no symptoms. June 13, 1921, three years and six months after being wounded, noticed hematuria, with severe aching pain in the left loin. Radiograph showed numerous small shrapnel fragments in the back and buttocks, especially numerous on the right side. No calculi seen on the right side. A calculus, the size of a large bean, was demonstrated in the lower calyx of the left kidney. The urine from bladder and separate kidneys all showed definite signs of a mixed infection. Very slight impairment of kidney function. Both kidney pelves were treated by repeated lavage, with considerable improvement in symptoms. February 18, 1922, patient again complains of considerable pain in left loin, but has not noticed further hematuria. Operation will probably be necessary in the near future.

Case 17. R. T. S., aged thirty-seven, electrician. First examined June 13, 1921.

History. November 12, 1915, while an ambulance driver, fracture of the left femur, which was either wired or plated. Had moderate suppuration in wound, which, however, healed in seven weeks. In March, 1916, four months after his operation, had first aching pain in the left loin, which pain persisted until June, 1921, when he came to me from the nephritic ward for investigation. June 22, 1921, the bladder and both kidney urines showed a moderate number of pus cells; a few red blood cells; no casts. Total 'phthalein, 62 per cent. Radiograph showed a calculus the size of a hickory-nut, low in the pelvis of the left kidney. June 24, 1921, a mulberry-type calculus, the size and shape of a peach-stone, was removed by a pyelotomy. Seven days later, patient had a secondary hemorrhage, necessitating a blood transfusion and subsequent nephrectomy. Ultimate recovery uneventful.

Case 18. J. R., aged thirty-three, railwayman. First examined June 28, 1921.

History. March 20, 1916, shrapnel wound of left upper arm and loss of right eye. Prolonged suppuration and five operations on left arm until January, 1918. In April, 1918, had what seems to have been a right pyelitis. No stones found, on repeated radiographs. Complete symptomatic recovery. In April, 1921, nearly five years after being wounded, and three years after a right pyelitis, he had his first renal colic. June 28, repeated severe attacks of colic drove him to hospital. Urine showed mixed infection of bladder and right kidney pelvis, while urine from left kidney was sterile on culture. Radiograph showed a calculus, the size of a pea, touching an opaque catheter in the right ureter in its upper third. July 28, 1921, after two lavages of right kidney pelvis, and the passage of no. 8 French catheter, patient passed a calculus the size of a split pea. August 1, radiograph showed the same shadow in the same position as in the former plates. Patient feeling well, and declines further treatment at present.

Case 19. W. B., aged twenty-six, machinist. First examined September 5, 1921.

History. August 12, 1918, multiple shrapnel wounds of right thigh and buttock; wounds excised and healed in six weeks. No injury to bone recorded. In 1916 and 1917, was in hospital four months with trench fever. From August, 1919, to January, 1921, was treated for nephritis, having, during this time, frequent mild attacks of aching pain in the left groin, accompanied by slight urinary disturbance and chilliness, followed by fever. September 5, 1921, bladder urine showed moderate pus and a few colon bacilli; no casts or albumin. Left kidney urine sterile on culture. Very slight impairment of kidney excretion, by 'phthalein test. Radiograph showed a calculus, the size of a pea, in the left ureter, about the junction of upper and middle third, touching the opaque catheter. The left ureter was gradually dilated until a no. 8 French, and a no. 6 French catheter could be easily inserted, side by side. September 15, radiologist reported the shadow in the ureter appeared about four inches lower than in plate of September 5. September 20, 1921, left ureter again dilated with no. 11 French bougie. On September 26 and on October 22, patient passed a small, irregularly-shaped, greyish calculus per urethram. November 20, 1921, radiography failed to show any shadow suspicious of calculi. Recovery uneventful.

Case 20. B. W. C., aged twenty-seven, jeweller. First examined November 25, 1921.

History. March 14, 1917, extensive shrapnel wound of left thigh. Wound suppurated and small sequestra discharged. Two subsequent operations of removal of sequestra, etc. Wounds healed in six months. In January, 1918, had severe attack of pain in right groin, and appendix was removed. From January, 1918, to August, 1919, had repeated similar attacks, but, latterly, pain localizing in right loin. In August, 1919, radiograph showed calculus in right kidney, which was removed by a general surgeon. Recovery uneventful. November 11, 1921, first recurrence of right renal colic since previous operation. November 25, 1921, bladder urine showed moderate pus and a few red blood cells. Total 'phthalein, 60 per cent in one hour. Radiograph showed a calculus, the size of a cherry, in the lower pelvis of the right kidney. Lavage of kidney pelvis, with moderate dilatation of right ureter, relieved symptoms temporarily. On January 9, 1922, a soft branched calculus, completely filling the middle calyx, was removed by nephrotomy. Recovery uneventful. This kidney pelvis has been lavaged and the ureter dilated three times since operation. Solutions of mercurochrome and silver nitrate were used, with improvement in the infection. Patient is still under observation.

All the cases here reported occurred in men. The oldest was thirty-seven years, the youngest, twenty-two years, the average being 28.5 years. Eleven occurred in the third decade of life, 9 in the fourth decade.

Five patients had been subjected to thigh amputations, and were consequently less active in their habits of life during the two or three years immediately preceding. Of the 20 patients, 9 might be said to have, of necessity, led a sedentary life from the nature of their wounds, while in the remaining 11 no change in the activity of their habits could be said to have taken place.

Three cases were found to have bilateral calculi; of the unilateral calculi, 11 occurred on the right side and 6 on the left, which proportion of right to left corresponds roughly to the opinion of recognized authorities on this phase of the subject.

Four had previously passed, or had calculi removed.

The average period of time elapsing from the date of receiving wounds to the date of the first renal symptoms, was 17.7 months, the longest period being 44 months, the shortest, 4 months.

In every case, with the possible exception of case 19, there appeared to be a very definite history of bone suppuration, with the systemic infection always present with osteomyelitis.

A history of a systemic infection having no relationship to wounds is found in three cases shortly before, or soon after, being wounded, viz., in case 3, furuncles of the trunk and back; in case 15, influenza, and in case 19, trench fever. It would appear to be more than a coincidence that in these three cases the suppurative process in the wounds was of comparatively short duration.

Four of these patients had been subjected to appendectomy, and 4 had been treated for considerable periods for nephritis before nephrolithiasis was suspected.

The urine from the affected kidney in 18 of these cases showed well marked characteristics of infection, the commonest offending organisms being the staphylococcus aureus and the bacillus coli communis; in 1 case, the urine showed no signs of infection on repeated microscopic examination, but no culture was made, and, in 1 case, the urine from the affected side was sterile on culture (case 18).

Staphylococci appeared to be by far the most common infecting organisms, very frequently associated with the Bacillus coli, and in no case were streptococci found. In making the foregoing statement, it is admitted that in the great majority of these cases cultures of the urines were not made as a routine, and that microscopic reports on the urines were relied upon. The bacteriology of the urine was investigated in a few cases where post-operative treatment by autogenous vaccines seemed indicated, and in every case the predominating organism proved to be Staphylococcus aureus.

The function of the affected kidney, judged by the excretion of phenolsulphonephthalein or indigo-carmine given intravenously, in 16 cases, was very slightly impaired,—in 1, moderately impaired, and in 3 cases, markedly impaired.

In 12 patients, the calculi were removed by operation; in 6, the calculus causing the symptoms was passed or removed after intraureteral manipulations, while in 2, no removal has been attempted but symptoms were apparently improved and temporary relief given by dilatations of the ureter and lavage of the kidney pelvis. The diagnoses in these 2 cases have been repeatedly confirmed by radiography, persistent slight hematuria, etc.

Three of the cases operated had previously been operated for removal of calculi. In several of the latter cases operated, in whom the urine persisted in showing considerable pus from the affected kidney, gradual dilatation of the ureter, with lavage of the kidney pelvis, has been carried out over a considerable length of time. In a few cases this post operative treatment has been supplemented by the administration of autogenous vaccines, though any definite benefit from these vaccines alone has not been noticeable. In only 2 cases was marked evidence of retention in the upper urinary tract from ureteral strictures or kinks, misplacement of the kidney, malformation of the kidney pelvis, found either on cystoscopic investigation or at operation. Investigation of this phase of the subject could, however, have been more throrough.

CONCLUSIONS

1. While definite conclusions, applicable to all cases of nephrolithiasis, cannot be drawn from 20 cases, there is undoubtedly a very definite etiological relationship between the bone suppuration and the formation of renal calculi in the cases herein reported.

2. Approximately 90 per cent of these cases show definite signs of infection in the urine from the affected kidney, which fact, together with the literature quoted, is fairly good presumptive evidence that infection is a definite contributing cause, if not the most important cause, of renal calculi.

3. Lack of drainage in the upper urinary tract is seemingly not an important primary cause of the formation of renal calculi following such a systemic infection as osteomyelitis.

4. Sedentary habits of life likewise have no direct relationship to calculus formation, where such formation follows a systemic infection as osteomyelitis.

5. If every case of nephrolithiasis could be investigated with sufficient thoroughness, a history of a preceding systemic infection could be elicited. Until such time as experimental and

clinical investigation gives us some other definite cause, might not the presence of nephrolithiasis be considered presumptive evidence of a previous systemic infection?

6. The removal of calculus from the upper urinary tract should be considered only an important preliminary step in the cure, and treatment of the concurrent infection must be thoroughly carried out if recurrence is to be avoided.

REFERENCES

Prout: Diseases of the Urine, London, 1821.
Legueu: Les Calcules du rein et de l'uretere, These, Paris, 1891.
Schade: Munich, Med. Woch, 1909, no. 1.
Wright, A. E.: Vaccine therapy, its administration, value and limitations. Lancet, London, September 17, 1910.
Wright, A. E.: Vaccine therapy. Lancet, London, September 17, 1910.
Ohlmacher: Bacteriology and Bacteriotherapy of renal calculus and its sequels, Jour. Amer. Med. Assoc., April 19, 1913, lx, 1213.
Cabot, Hugh: Modern Urology. Lea and Febriger, Philadelphia and New York, 1918, 131.
Mayo, C. H.: Stone in the kidney, Ann. Surg. 1920, lxii, 123.
Stengel and Fox: A Text-Book of Pathology, 7th edition, W. B. Saunders & Co., Philadelphia and London, 1921, 1111.
Mayet, M. H.: Calculus in both kidneys in a child immobilized by Potts' disease, Paris Chirurg., 1920, xii, 132.
Cabot, Hugh: Remarks on the technique of operations for stone in the ureter, Jour. Amer. Urol. Assoc., 1910, iv, 204.
Rochet and Boulouneix: Cases of Renal Lithiasis observed at the urological Centre of the 14th Army Division (1915–1918), Jour. d'Urologie, 1917–1919, vii, 225.
Cathelin, F.: Urinary calculi in the army. Jour. d'Urologie 1917–1919), vii, 531.
Rosenow, Ed. C. and Meisser, Jno. G.: Nephritis and urinary calculi after production of chronic foci of infection. Jour. Amer. Med. Assoc., lxxviii, no. 4, 266, January 28, 1922.

DISCUSSION

Dr. Leon Hermen, Philadelphia: I regret that I did not hear all of Dr. Paul's paper, but wish to invite him to come to the Pennsylvania Hospital tomorrow to see a case there. We had found the Staphylococcus aureus in pure culture from an osteomyelitis of the tibia, and one day the nurse noticed that the right leg was apparently paralyzed Roentgenographic examination showed spontaneous fracture of the neck of the right femur. Last September he developed kidney symptoms and we found that he had 3 stones in each ureter and calcification of the left kidney. I cystoscoped him and the following day he passed 3 stones from the right side and two or three weeks later passed a stone from the left ureter. He is now doing well. His right kidney is apparently normal and the left is apparently destroyed entirely, and we are contemplating nephrectomy. This is an instance of stone-following osteomyelitis in an eight-year-old boy.

Dr. A. J. Crowell, Charlotte, N. C.: I wish to say that Dr. Paul's paper is an endorsement of the opinion we have had for a number of years, namely, that there is a close relationship between kidney stone formation and kidney infection. This conviction has been so strong that our custom has been to follow pyelolithotomy with pelvic lavage until the infection has cleared up. Any debris in the kidney pelvis acts as a nucleus upon which the salts or other constituents of the urine may be deposited. To say the least, there is a great tendency to nephritic stone re-formation and this to me is a reasonable explanation of their tendency to recur.

Dr. Granville MacGowan, Los Angeles, Cal. (closing): I have changed my viewpoint in regard to angioma of the papillae of the kidney in the last ten or fifteen years. Originally, in the early part of the century, between 1906 and 1907 to 1910, I operated on 3 cases, hemisectioning the kidney. It did not seem to me to be such a very dangerous operation. These men were all cured. I resected diseased papillae of the kidney twice with a knife and once with fire successfully. In 1912 I did the same operation for one of my dearest friends. I sewed the kidney up with mattress sutures in the usual manner. The preparation of these sutures was of such nature that one would be led to believe that they would not be absorbed for twenty-one days. On the fifth day I was called from the theater at about ten o'clock to look after him. He had been bleeding for an hour and a half before I reached him. I immediately removed the kidney, but his life was sacrificed, he died as a result of the hemorrhage; and that experience was a very disagreeable one.

On looking the literature over I have been able to find only one definite case of angioma of the kidney. That is reported by Swan (Proceedings of Royal Society of Medicine, June, 1920, p. 35) which was not an angioma of the papillae. The sections I showed today are not those of angioma of the papillae but of varices of the papillae, and on looking through the literature I have found the illustrations to be sections of varices. It is very difficult to tell on opening the kidney and looking at the diseased papillae whether the changes are of true angiomatous nature or those of varices. The ones I have found have all been in the upper pole of the kidney and the rough measures introduced by Fenwick are not applicable for treatment of these lesions in the upper part of the kidney, I am very much inclined to believe in treating this condition we should follow the proposal of Dr. Hugh Young, that we use up whatever measures we have, that are not radical; the taking of a pyelogram, the injection of nitrate of silver, the use internally of stypticin, the injection of the pelvis of the kidney with adrenalin, any one of which seems to control, for a time at least, the hemorrhage, and that we put off the operation of nephrectomy until it is forced upon us for I certainly would not now, after my experience on my friend in 1912, advise any one—no matter how competent—to split the kidney for the removal of varicosities or for angiomatous degeneration of its papillae.

Dr. H. Ernest Paul, Toronto, Ontario, (closing): I wish to say that the French literature points out, in almost every instance, that it is not the question of osteomyelitis in itself; emphasis is laid upon the injury to the bone marrow and the three cases quoted from the French literature do not seem to me to parallel the sort of cases discussed in this paper. My idea is that if we could go deeply enough into the history of a great many cases of nephrolithiasis we would find a history of a previous systemic infection. You have all heard doctors say that if you removed a stone every week from certain patient they would still go on re-forming. I agree with Dr. Crowell that there should be some preventive treatment for re-formation. In one case the man has been operated upon three times, the last time at Mayo Clinic. He has now been on lavage of kidney pelvis for six months, without re-formation of the stone.

PYONEPHROSIS[1]

IRVING SIMONS

Nashville, Tennessee.

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The non-tuberculous variety of pyonephrosis, or end-stage of pyogenic inflammation of the kidney, has in its beginning a varied etiology, many factors of which may be demonstrated in pyelographic studies of kidneys, which have not yet advanced to this terminal stage of destruction. At present we are justified in considering several modes of renal infection.

In the hematogenous, or descending, type we are agreed that there occurs from time to time a transient bacteriemia, having its origin for the most part in the intestinal tract; in the effort of the kidney to eliminate these organisms a certain amount of renal damage is incurred. More rarely nephritis or acute septic infarcts of the kidney are the result. There is great probability that some cases of nephritis (Brights) are due to these repeated insults.[2]

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[1] Read before the American Urological Association, April 27, 1922.

[2] The etiology of chronic nephritis (Bright's) is still largely problematical, and we must still revert to the time-honored toxic materials of unknown origin. However it has been shown that when the body has become moderately immune to the organisms that may circulate in the blood, slight renal damages may repeatedly occur, leading to the typical contracted kidney. The organisms that most probably act in this way are strains of the streptococcus viridans, which are found in the naso-pharynx. These organisms not being pyogenic, in the sense of ordinarily liquefying tissues, are known to cause embolic focal nephritis (i.e., lesions of single glomeruli or even parts of a glomerulus, as was first shown by Loehlein), resulting finally in a severe grade of contracted kidney; in outspoken cases of chronic streptococcus viridans endocarditis, where masses of bacteria are thrown into the kidney, there are gross infarctions in addition to these microscopic lesions, and such cases die of their bacterial infection in from a few weeks to a few months, due of course to the continuous bacteriemia; there are however cases, in which the fulminating bacterial invasion is overcome, and some of these die years later, either of renal insufficiency, or cardiac decompensation; in such

To the surgeon, however, the interest in this condition, lies in the fact that there are a small number of renal cases, which are

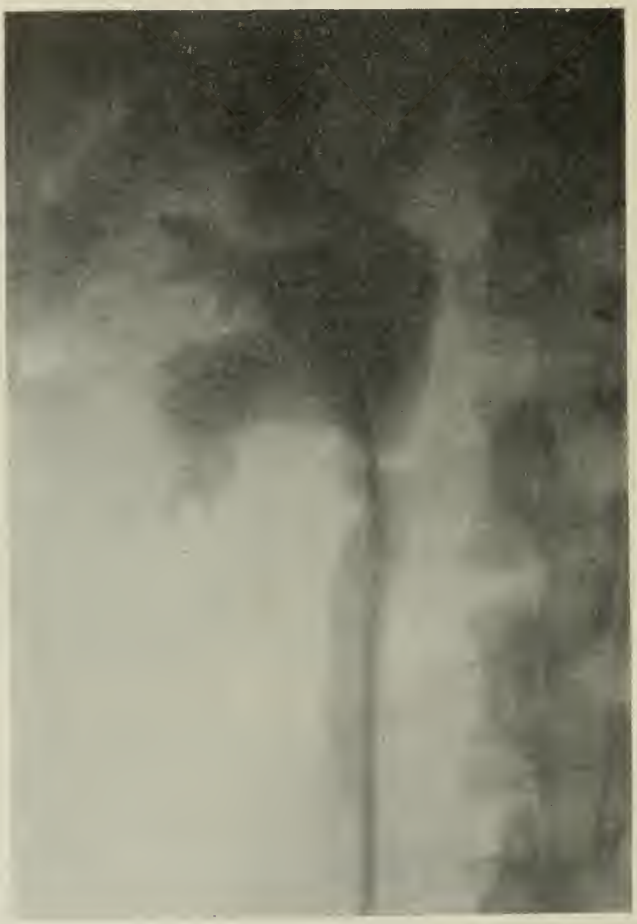

FIG. 1 COLON BACILLUS PYELITIS

Note the twist at the ureteropelvic junction; cured by lavage

kidneys, the terminal sclerotic focal changes of chronic Bright's disease are easily demonstrable and the valvular lesions of the heart show that the valves had previously been the seat of active vegetative endocarditis of bacterial type (see Loehlein, Aschoff, Gaskell, Baehr, Simons-this subject is discussed in the article of Bacterial Endocarditis chiefly under the section on Pathology of the Kidney).

usually unilateral, but which may later show symptoms on the other side, and which manifest their presence by more or less severe renal hematuria or nephralgia or both. These are the cases described as nephralgia with hematuria, painless hematuria, renal hemophylia or essential hematuria, but they seem to be for the most part, as Kapsammer says, bleeding kidneys with relatively slight anatomic lesions and those usually of chronic

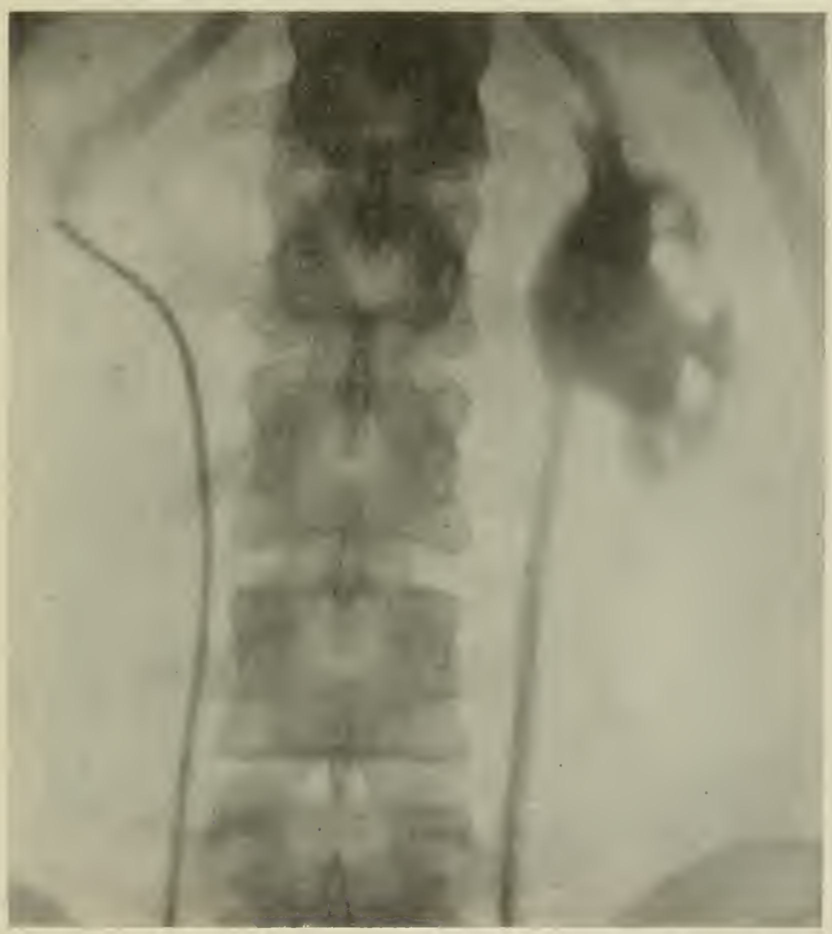

Fig. 2. Colon Bacillus Pyelitis

Operated upon for appendicitis; cured after operation by lavage nephritis. Let it be understood that these cases are to be differentiated clincally from the hematurias that occur occasionally (more often than this, according to Kidd) in extremely acute pyelitis or pyelonephritis, as these latter have fever and can be shown to be infected with microörganisms.

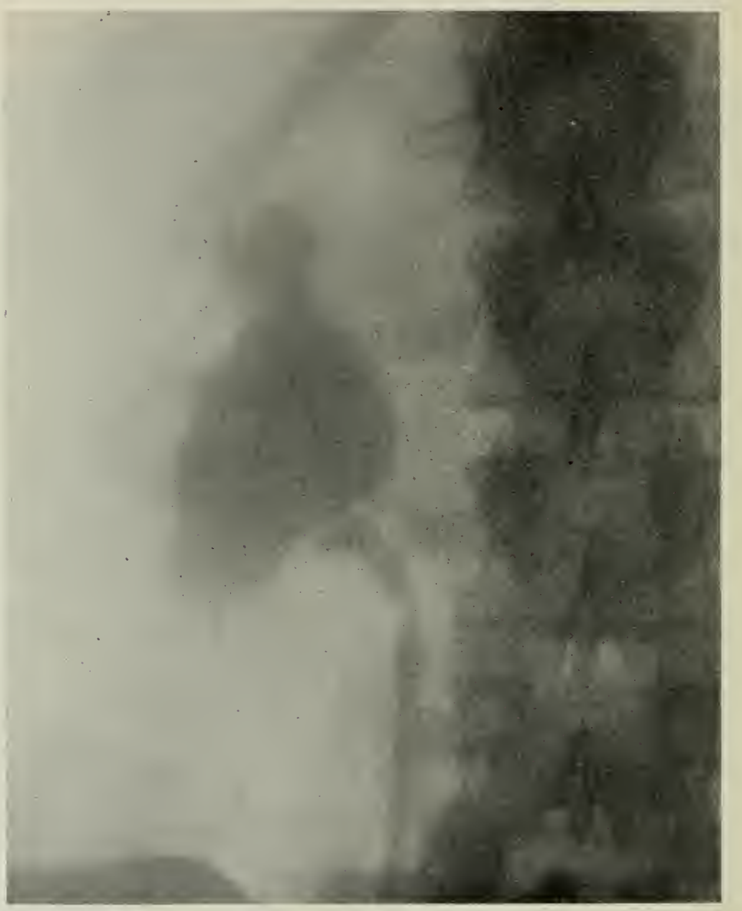

Fig. 3. Colon Bacillus Pyelitis

This stage was already pyelonephritis with uronephrosis; nephrectomy; recovery.

In the case of acute unilateral septic infarction of the kidney we are accustomed to expect the streptococcus pyogenes or the staphylococcus aureus and rarely the colon bacillus. These cases are rare and, when fulminating, die unless operated upon. Some have been shown to resolve without complications (Cunningham), but as a rule the cases that resolve are those in which there is only destruction of a part of the renal cortex with a resultant pointing in the loin (perinephric abscess) and these are mostly staphylococcus aureus cases.

Up to this point there has been discussion of very little material that can be said to be a forerunner of pyonephrosis, except that the appearance of the kidney of acute septic infarct, with its numerous large triangular purplish discolored wedges, situated in the Malpighian areas, is strongly suggestive of many pyonephroses, whose cavities, filled with liquefied or inspissated pus, form the same type of topography. It it is true that some of these generally infarcted kidneys can recover spontaneously, it does not seem improbable that these areas could later break down and communicate with the renal pelvis forming pyonephroses.

Such a pyonephrosis I have seen develop not many months after a blow in the loin, which resulted in fever the next day and a course ending in total renal destruction.[3]

Having disposed of those rarer conditions of the kidney due to hematogenous infection, we now come to the condition that is the forerunner of the largest proportion of pyonephroses, at any rate the largest proportion of unilateral pyonephroses, that come to the surgeon for relief. These are the cases of pyelitis (pyelonephritis) usually due to the B. coli, usually beginning as acute processes, but at times subacute or chronic when first seen.

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[3] In connection with this it is interesting to recall some experiments of Albrecht, who injected rabbits intravenously with staphylococcus aureus and some months later bruised the kidney through the loin and produced renal and perirenal abscesses, that were not produced in control animals; suggesting that groups of actively pathogenic organisms might remain quiescent in a kidney until trauma started their activity. This was also done some years previously by Schnitzler.

Such cases for the most part get well spontaneously or with pelvic lavage, but in many cases are strangely quiescent from their onset and gradually undermine the kidney, before the patient is first seen by the surgeon. If this occurs in a kidney that is the seat of more or less well developed hydronephrosis, a uropyonephrosis results.

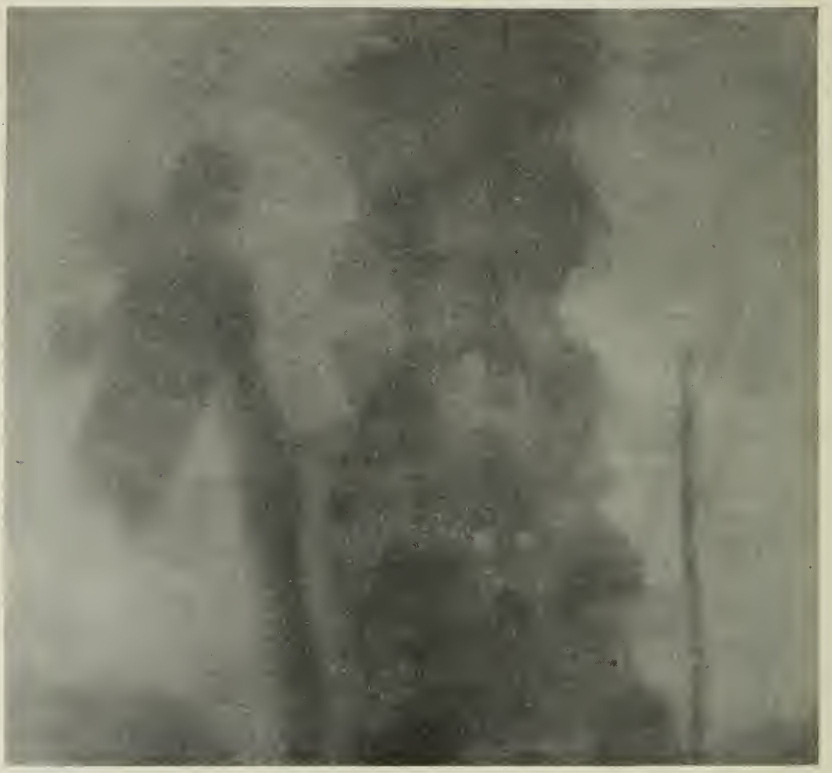

Fig. 4. Advanced Pyonephrosis as a Result of Prolonged Pyelitis; Nephrectomy; Recovery

In the ascending or urogenous type of pyonephrosis, we are dealing with a bilateral condition which is the terminal stage of renal infection resulting from severe chronic cystitis, with the addition of organic obstruction in the lower urinary tract, or its equivalent (i.e. neurologic bladder). This is the socalled surgical kidney of the older writers and is rarely surgical at all.[4]

CLINICAL ETIOLOGY OF PYONEPHROSIS OF HEMATOGENOUS ORIGIN

This type is usually unilateral and as a general rule has a history of long standing or repeated attacks of pyelitis (Figs. 1, 2, 3, 4, 5).

It is more common in women, probably due to the fact that pregnancy renders them more liable to pyelitis, and relaxation of the abdominal wall is often the forerunner of nephroptosis (Figs. 6, 7).

Trauma to the kidney (32) may result in pyonephrosis and this is especially likely in cases of fracture of the kidney due to a blow (72) or a gunshot wound (Fig. 10).

The pyelograms of acute pyelitis of short duration are apt to be fairly normal, but in the case of congenital anomalies such as primary hydronephrosis (38, 8, 80) an infection of the renal pelvis is of more concern; again, obstructions in the ureter such as kinks (122, 132, 138), twists (30) or strictures are of grave import; some of these are congenital and others are the result of chronic ureteritis.

Obstruction in the pyelon or ureter may be caused by stone (86, 88, 36, 44, 22) and with the resulting uronephrosis, an added infection is apt to cause the most advanced pyonephrosis. It should be remembered also that stones in the kidney itself invite further infection and are common causes of pyonephrotic sacs.

The above sums up in a general way the more common causative forerunners of pyonephrosis, demonstrating in skiagrams and pyelograms the conditions enumerated.

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[4] While these two routes of infection are the most commonly recognized, one should not forget that some interesting and suggestive work has been done on animals which would lead to the conclusion that some infections of the kidney occur in an ascending manner through the submucous lymphatics of the ureter (Eisendrath and Schultz).

Also it has been held that the diapedesis of organisms can occur from the colon to the renal pelvis.

CLINICAL ETIOLOGY OF PYONEPHROSIS OF UROGENOUS ORIGIN

This group is usually bilateral and occurs mostly in men. It is the result of a prolonged chronic cystitis with obstruction in the lower urinary tract, such as, stricture of the urethra, prostatic hypertrophy of benign or malignant type, vesical neoplasm, etc. In some cases the equivalent of organic obstruction is produced by loss of nervous control of the vesical sphincters, as may occur in gunshot wounds of the spinal cord, or in advanced disease of the cord (system diseases, tumors, syphilis, etc.).

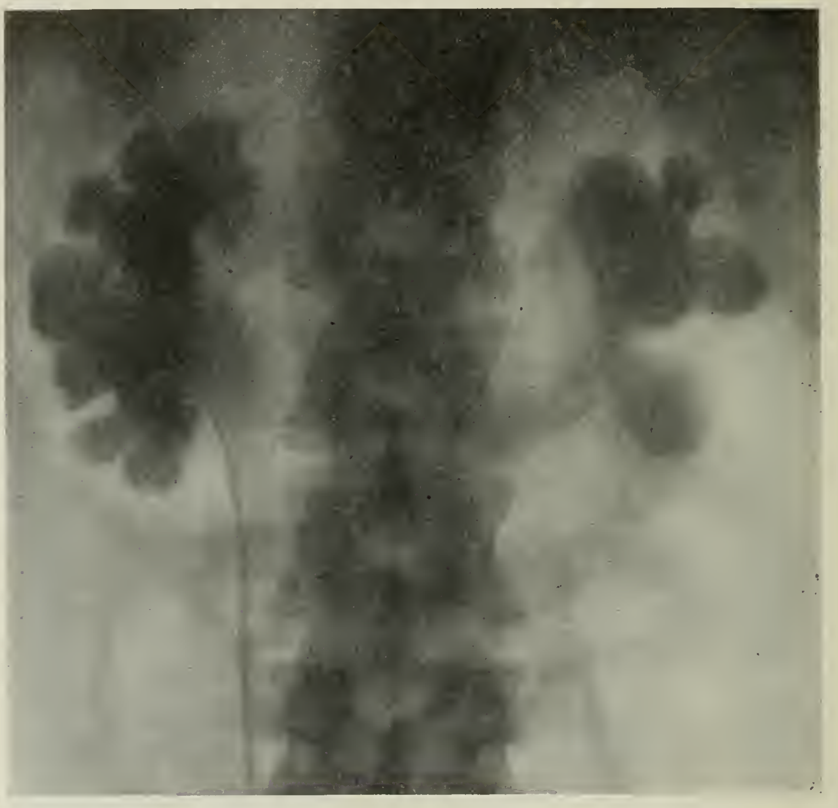

Fig. 5. Bilateral Pyonephrosis under Observation Four Years
Succumbed after nephrotomy, done on one side

MORBID ANATOMY OF PYONEPHROSIS OF HEMATOGENOUS ORIGIN

These kidneys vary in size from that of a slightly enlarged kidney, up to that of huge sacs, that extend from the dome of the diaphragm to the brim of the bony pelvis. The larger specimens are apt to show a lobulation which is explained on section of the specimen. As a rule the enlargement is chiefly that of the kidney proper, although the pelvis may enlarge, and this usually occurs when there is obstruction in the course of the ureter (stricture, kink, stone) or when the pyonephrosis is secondary to a primary hydronephrosis.

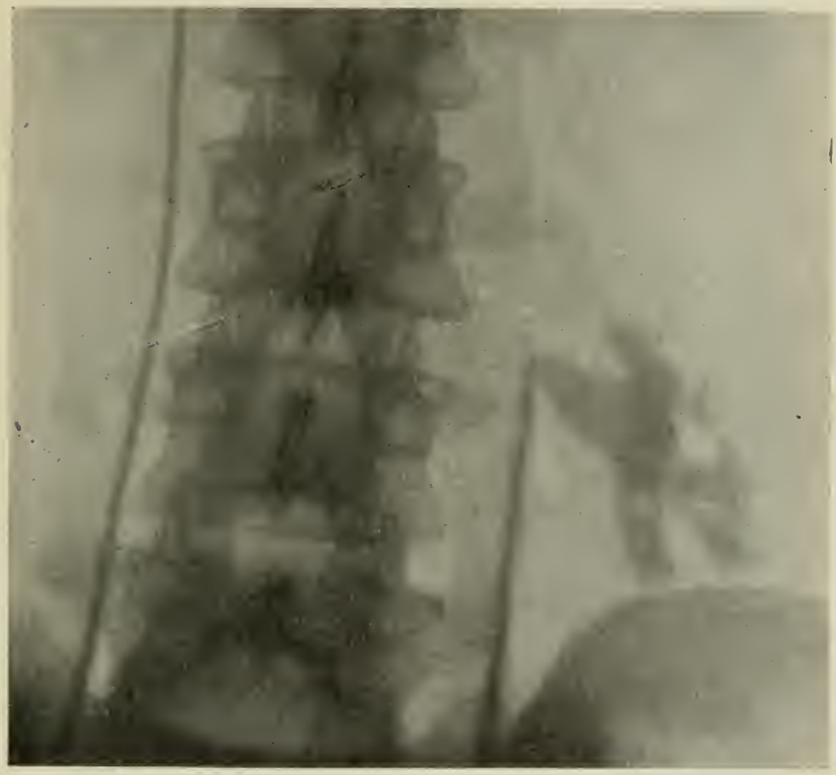

FIG. 6. NEPHROPTOSIS; NEPHROPEXY; RECOVERY

On section pyonephrotic kidneys show cavity formation, either in one part of the kidney or generally distributed; the cavities as a rule occupy the position of the destroyed and thinned out Malpighian areas. Rarely, in cases of congenital anomaly, such

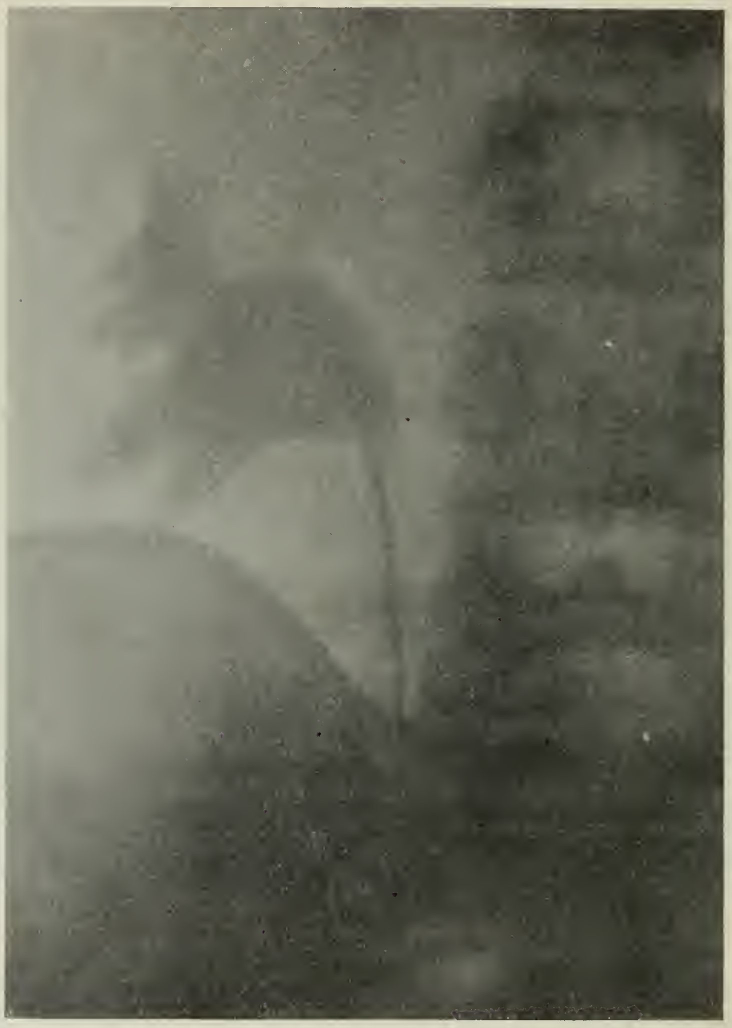

Fig. 7. Nephroptosis; Nephropexy; Recovery

as bifid ureter or double ureter, there may be partial pyonephrosis of a kidney. The partitions between the cavities (Bertin areas) are in some cases stiffened by fibrous tissue formation. There are in some cases greatly dilated (fist sized) pelves subtending small cavities, but most of the specimens are flaccid sacs, which collapse when cut, unless previously hardened.

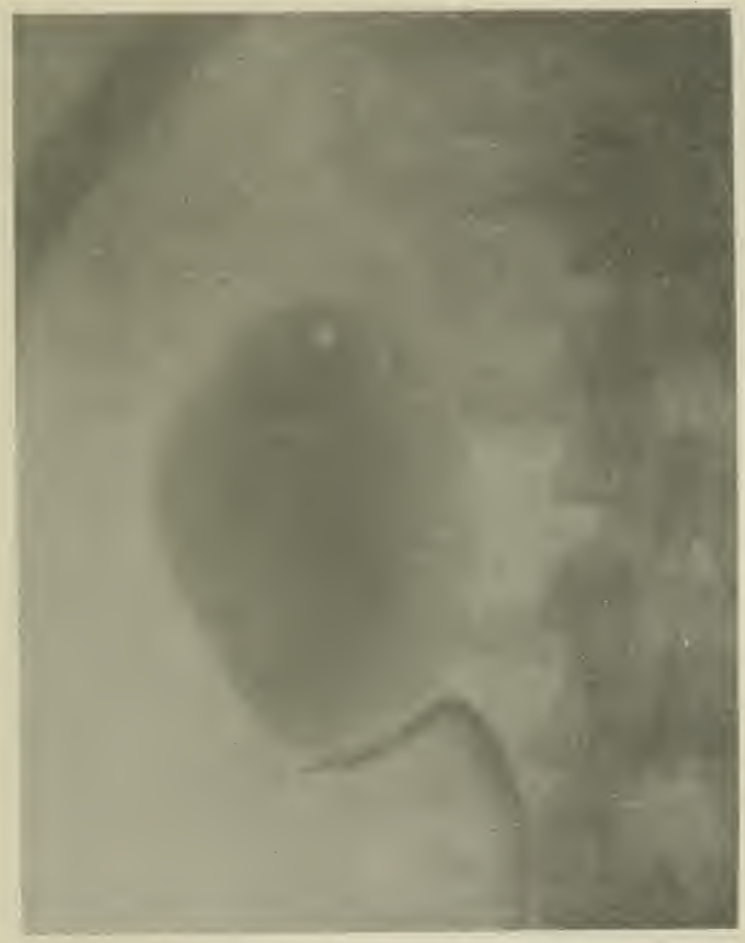

Fig. 8. Pyonephrosis Following Trauma

The shadow represents only the pelvis of an enormous sac; nephrectomy; recovery.

The hilus of some of the specimens is rendered firm by the proliferation of the fatty capsule extending up into the sinus of the kidney.

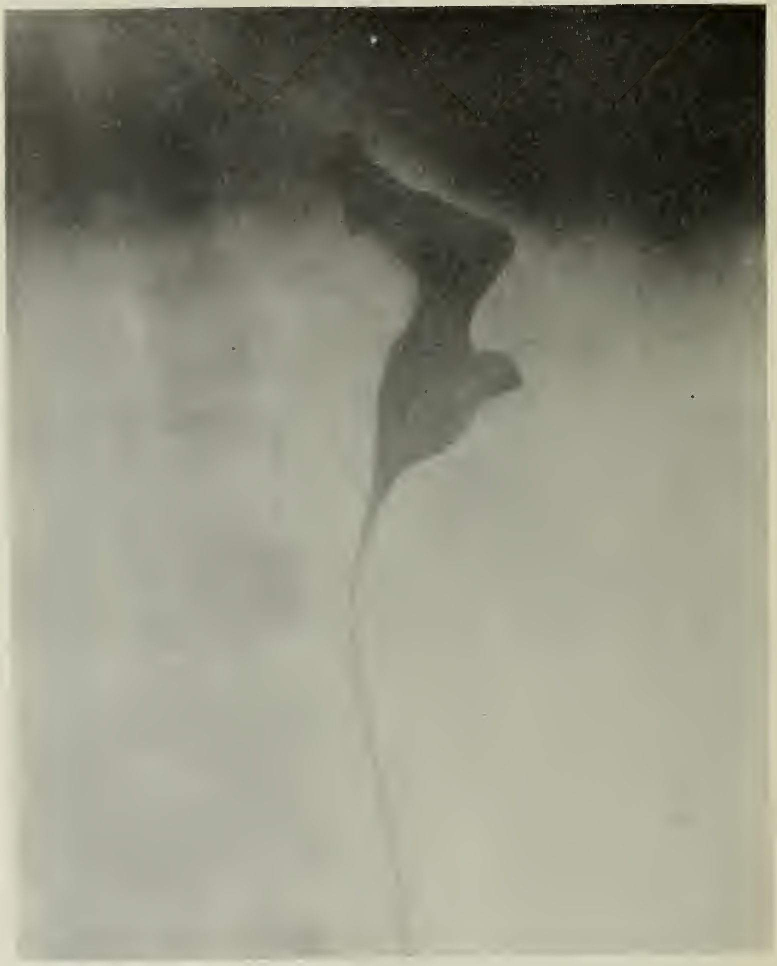

Fig. 9. Pyonephrosis Following Trauma

Fracture and destruction of lower pole of kidney; nephrectomy; recovery

The contents vary from thin purulent urine to creamy pus and in some cases inspissated pus in which calcium salts are deposited.

The pus may be odorless or foul, more often the latter. Calculi (of original type or secondary to pyogenic inflammation) may be found in the cavities, or the pelvis (where they are likely to be branching) or engaged at the ureteropelvic junction.

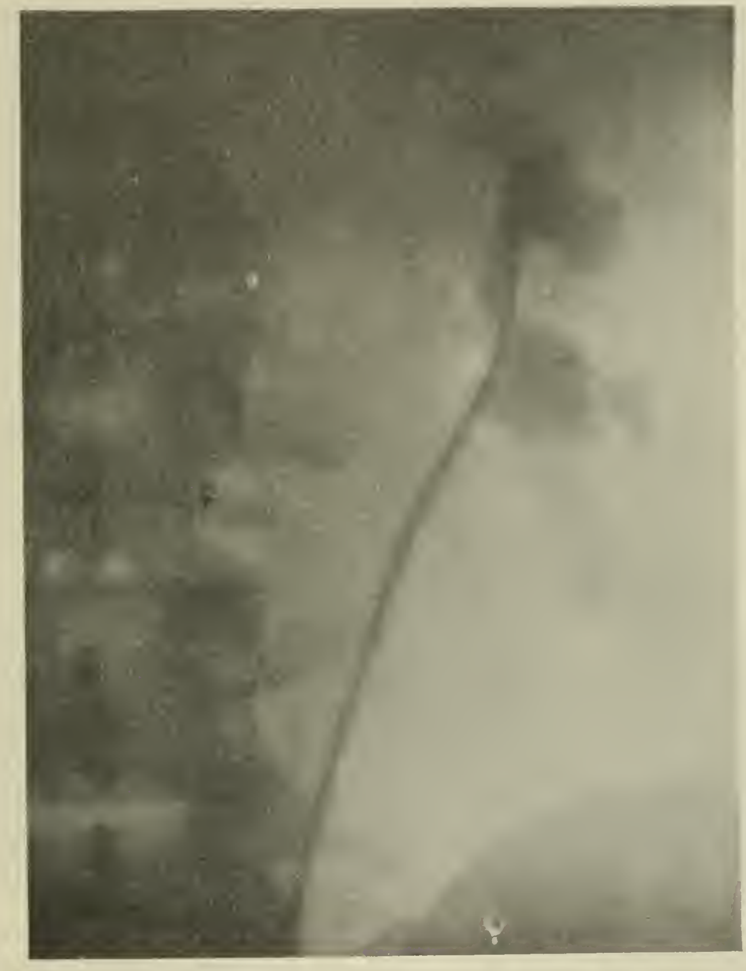

Fig. 10. Pyonephrosis Following Gunshot Wound

In some cases the ureter is closed at the point of obstruction, and allows the injection of fluid up into the pyonephrotic sac, but no efflux. Some of these kidneys eventually become closed pyonephroses and cure themselves spontaneously by autonephrectomy. In others the route from the renal cavities through pelvis and ureter to the bladder remains wide, allowing the discharge of thick pus.

The perinephric tissues usually show marked fat proliferation and induration (perinephritis fibro-lipomatosa) and can rarely be separated from the kidney without tearing off the true renal capsule, thus exposing the true renal parenchyma during the operation. At times the induration is so great as to be almost cartilaginous in toughness.

Small perinephric collections of pus (perinephric abscesses) may be met with during operation and at times there may exist sinuses between one pole of the kidney (usually the upper) and a cavity or organ such as the pleura, lung, gastrointestinal tract or spleen. At times abscesses may dissect downward into the true pelvis (pelvic abscess) or may simulate psoas abscess of vertebral origin.

Above the point of ureteric obstruction, the ureter is more or less dilated and thickened and may be as large as a small intestine, especially when there is stricture or stone in the lower ureter. The ureter below the point of obstruction may be fairly normal or merely the seat of moderately chronic ureteritis.

The lesions of the opposite kidney are of the utmost importance to the surgeons. Toxic nephritis is common. Pyelitis and pyelonephritis should not be overlooked. A normal or even a hypertrophic kidney is the rule, especially in cases where the pyonephrotic kidney is practically functionless for a long time, and when the constitutional symptoms have not been great enough to damage the sound kidney or have been well tolerated by it.

MORBID ANATOMY OF PYONEPHROSIS OF UROGENOUS ORIGIN

These kidneys may be more or less like the preceding but are usually bilateral, although one kidney may show more advanced destruction than its fellow. The ureteral lesions are more marked in this type on account of the mechanism by which the pathologic condition is produced (i.e., obstruction at the bladder neck or its equivalent). Consequently there is found in the ureters, marked thickening, dilatation, tortuosity, valve formation, etc. This ureteral dilatation usually extends upward to the kidney causing a moderate degree of hydronephrosis.

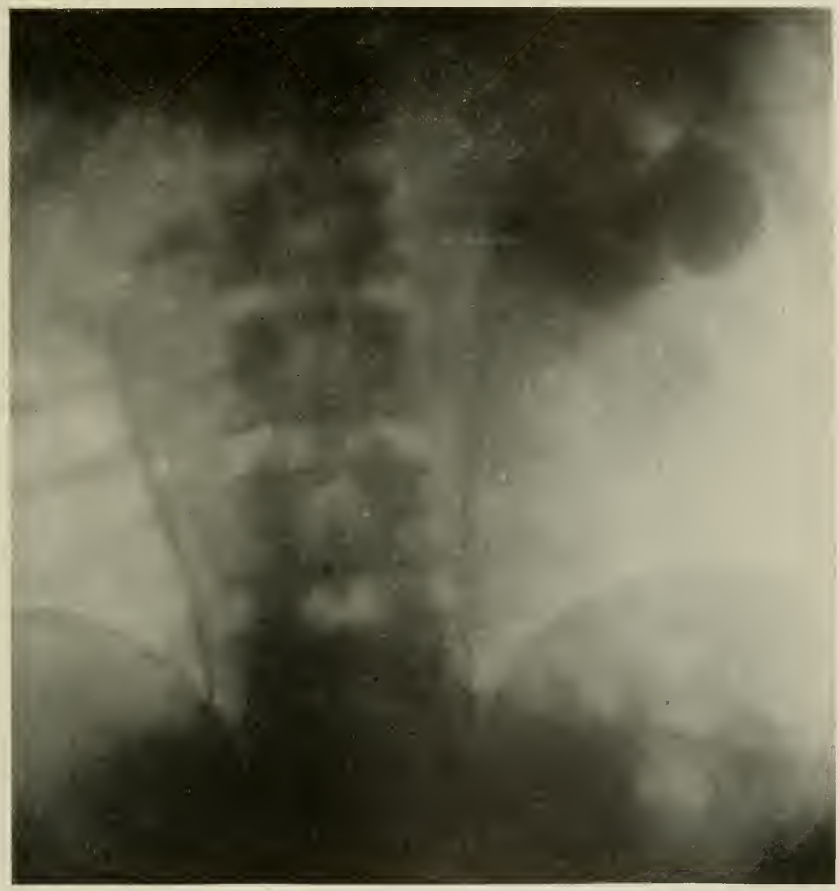

FIG. 11. ENORMOUS PYONEPHROSIS, PROBABLY OF CONGENITAL ORIGIN; NEPHRECTOMY; RECOVERY

CLINICAL FINDINGS IN PYONEPHROSIS

In a condition that represents the end-stage of kidney destruction a history of long duration is to be expected. It is really astonishing how many years these patients suffer before diagnosis is made. This is not due to the fact that it is difficult to make a provisional diagnosis, without urological study, but to the fact that the medical profession is still under the impression that most non-venereal urinary tract disturbances are cystitis and will get well on medication. The practitioner that takes the trouble to wash the bladder generally finds out pretty soon that more exact investigation is indicated.

A common clinical picture is that of the patient who has for months or years, either constantly or sporadically, passed cloudy urine with "phlegm in it" and often with a disagreeable or even foul odor. He does not see the specialist until he has an attack or two of fever with some pain in the loin and begins to lose a good deal of weight and strength.

Another picture is that of the woman, who has had a very irritable bladder (pyelitis), often following a labor, and who is subject to an attack of pain in the loin and fever from time to time.

Another picture is that of the patient who is gradually emaciating, and whose occasional fever and chills are thought to be due to malaria or pulmonary phthisis.

The cases following trauma are not always quickly suspected as the trauma to the loin may be apparently not severe and the fever may not increase to a degree to be noticed by the patient for some days or weeks.

The cardinal signs of pyonephrosis are pain in the loin, mass, fever and pyuria.

Pain in the loin is by far the most common and is usually localized, non-radiating, dull aching or boring in character.

Mass is the sign least often elicited, on account of the tenderness and on account of the difficulty in deciding in many of the cases whether the kidney is really enlarged or merely easily palpable, and in other cases on account of the thickness of the abdominal wall.

Fever is the most constant sign and is rarely absent over long periods, and in acute exacerbations may be very septic in character and associated with chills and considerable loin pain, when the discharge of pus through the ureter is prevented.

Pyuria is the most characteristic sign. The advanced case shows enormous quantities of purulent sediment which sinks down into the glass within a short time forming a creamy layer, that may occupy a quarter of the height of the specimen. This layer may be made up of ropy masses and above it the urine is cloudy with pus. The urine may be odorless or very foul. It is usually acid if infected with B. coli but in mixed infections may become alkaline. Such a massive pyuria in the absence of vesical diverticulum or hypertrophied prostate (with a large amount of

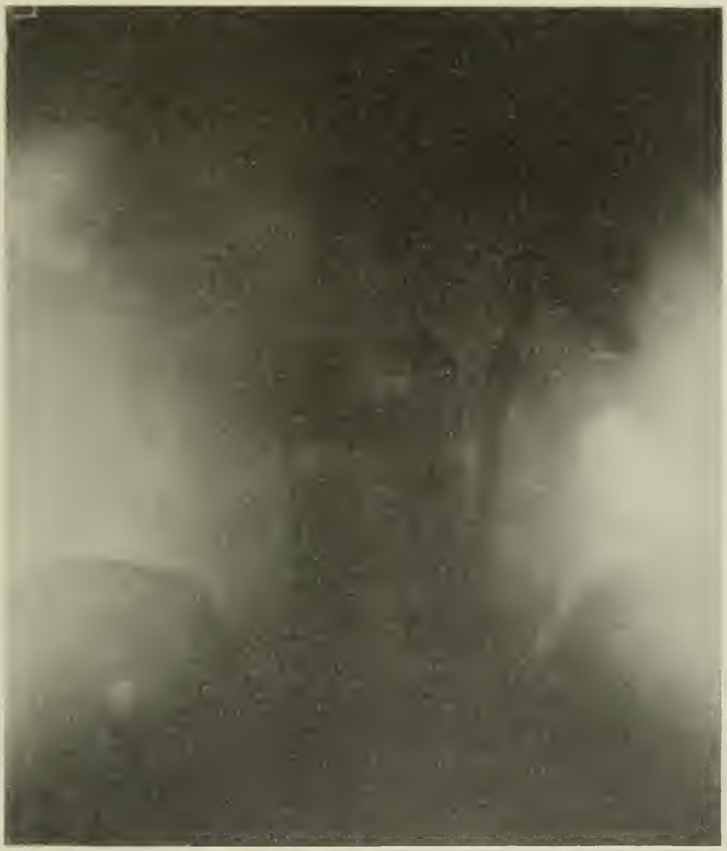

FIG. 12. SMALL PRIMARY HYDRONEPHROSIS; NOT OPERATED

residual urine), is almost diagnostic of pyonephrosis. While this type of pyuria is the common finding, it may be present only for periods in the course of the disease. When absent there is usually the slight cloudiness due to chronic cystitis.

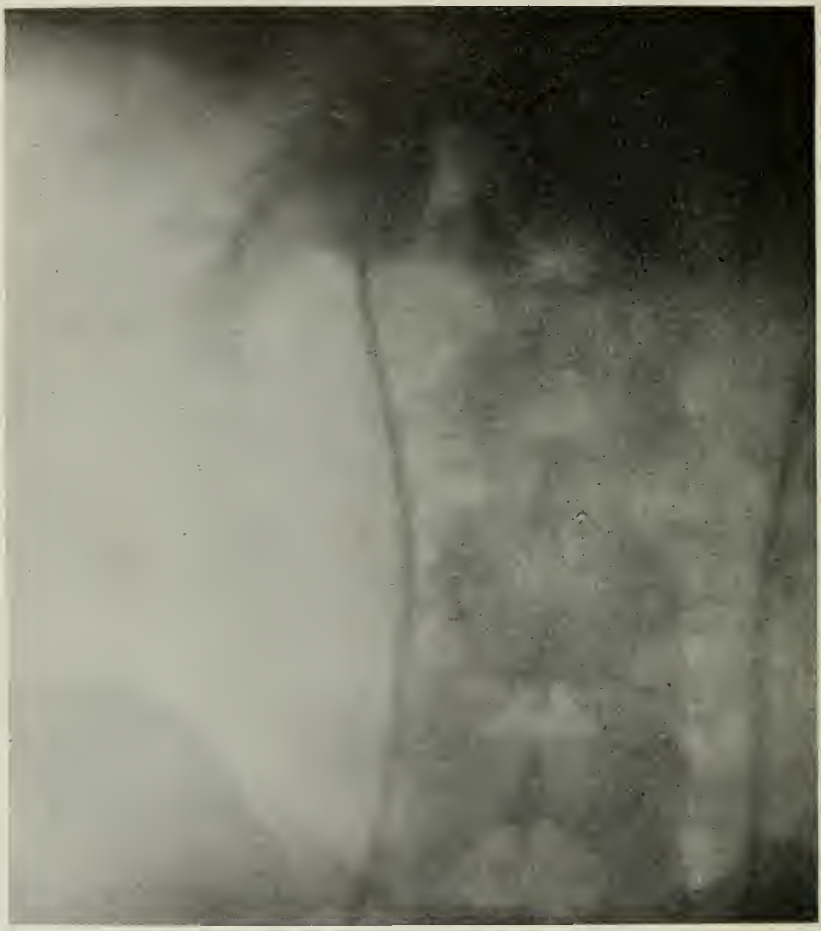

FIG. 13. SMALL PRIMARY HYDRONEPHROSIS; NOT OPERATED

The bladder as a rule becomes somewhat tolerant to the infection and frequency of micturition is not complained of to any great extent. The cystoscopy of these cases may be very difficult due to the difficulty in washing the bladder free of pus and usually requires constant irrigation. The bladder may show only the signs of moderate inflammation. At times there are portions of the mucosa covered with pus. The ureteric orifices may be

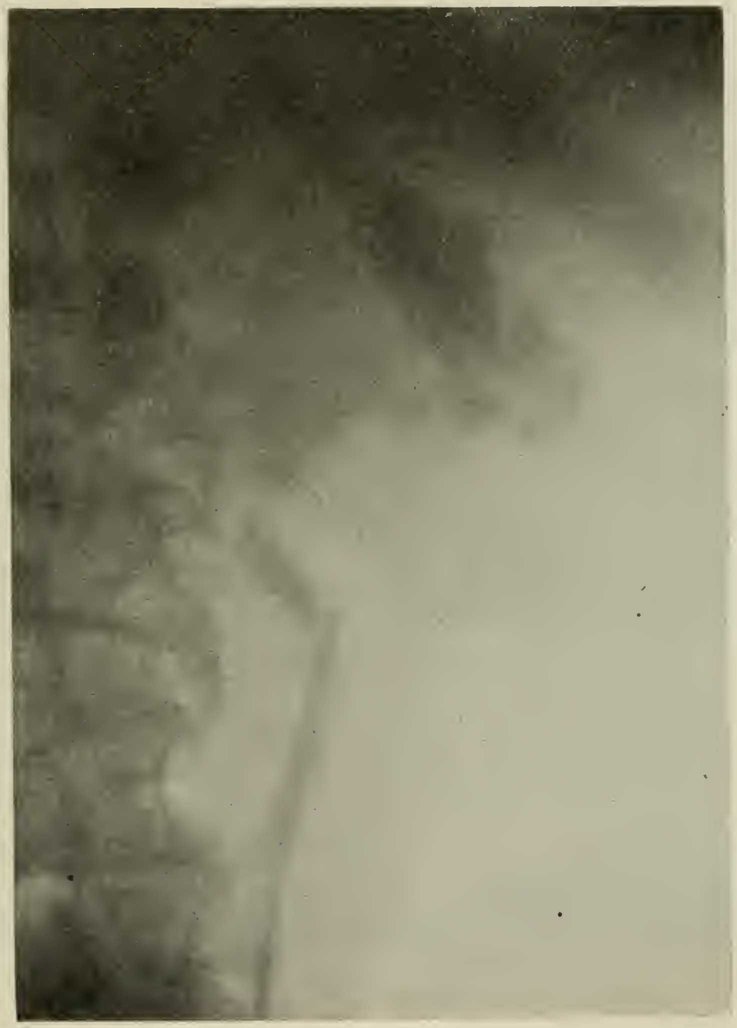

Fig. 14. Illustrative of Kink in the Ureter

little more inflamed than the rest of the bladder wall, but in some cases there is marked reddening and thickening on the side affected, but rarely the changes that are so common in tuberculous ureteritis. Meatoscopy may reveal a jet of cloudy urine or a white plug of pus may be seen emerging from the affected side. Ureteral catheterization may reveal on the affected side an absence of urine, when the kidney is practically destroyed. In some cases of this type purulent urine is occasionally obtained, which may be as thick as empyema fluid, and I have seen such

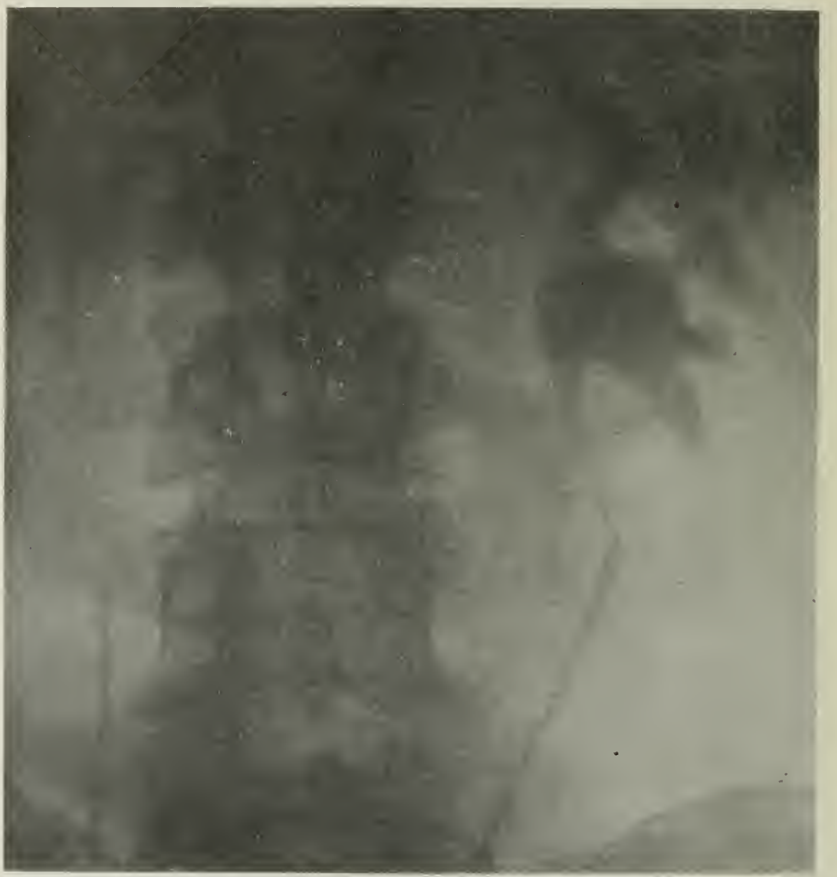

Fig. 15. Illustrative of Tilting of Ureter

fluid run through the catheter. Usually however the urine is merely moderately purulent.

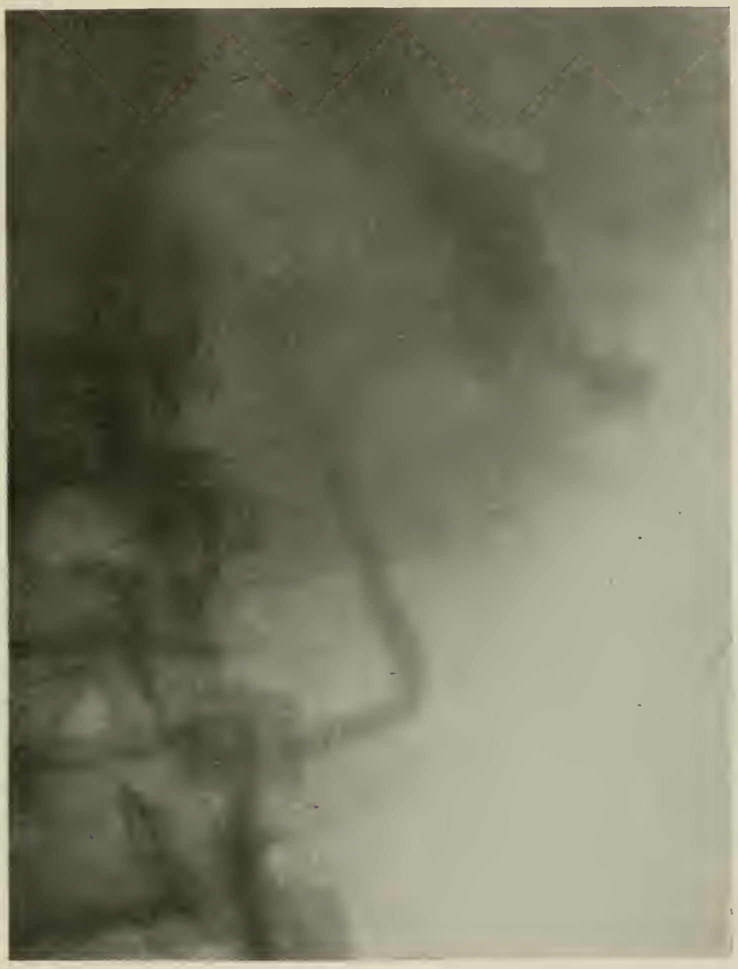

Fig. 16. Curious Aberrant Course of Ureter
Associated with severe attacks of renal colic; nephropexy; recovery

The bacteriology of the affected side is usually B. coli but occasionally mixed cultures occur. The bacteriology is similar to that of pyelitis (vide Simons, Pelvic Lavage, etc.).

Renal function is usually more or less depressed on the affected side and the phenolsulphonephthalein elimination is delayed both in time of appearance and in the amount of the dye eliminated in the usual periods. This diminution may approach practically zero and in some cases of course no secretion of any sort is obtained. On the opposite side the renal function is usually increased above normal in order to compensate and in some cases may approach an amount equal to the secretion of two kidneys. Uncommonly the secretion of the sounder side may be subnormal, due in all probability to inhibition or toxic damage, and it may rise only after removal of the diseased kidney.

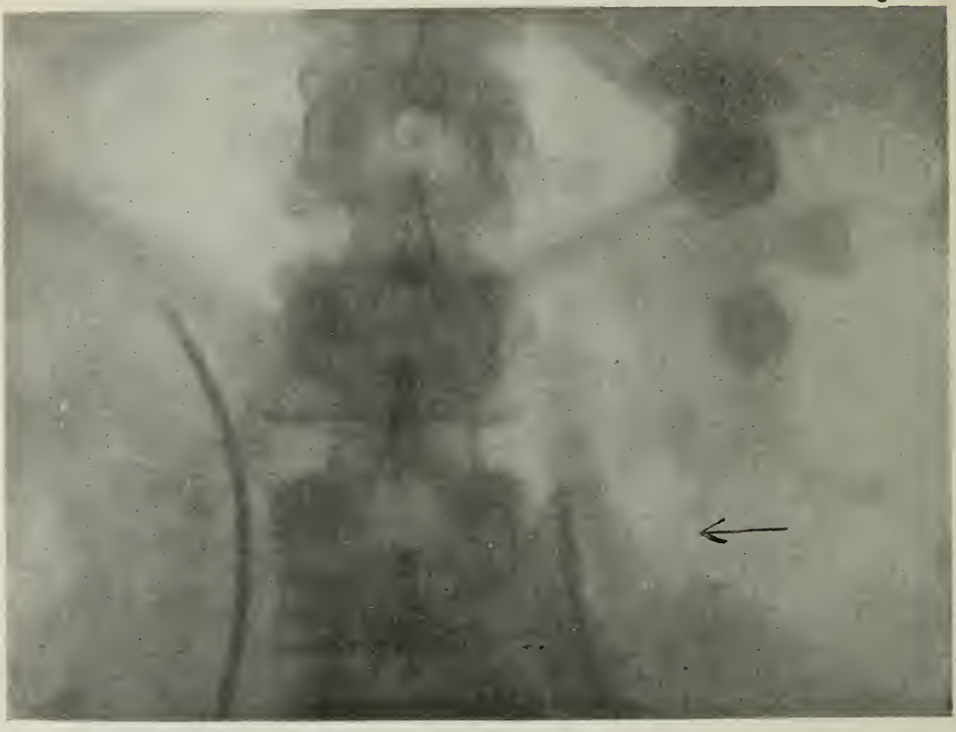

FIG. 17. WATER-TRAP TWIST IN THE URETER WITH SEVERE PYELONEPHRITIS OF PREGNANCY; NEPHROTOMY; RECOVERY

In radiography we have a great aid especially when the pictures are made with the shadowgraph catheter in place. In such investigations a moderately or very markedly aberrant course of the ureter may be demonstrated. Also with the very recent excellence in soft tissue detail obtained with films and double intensifying screens the outline of both normal and pathological kidneys can be expected. Different degrees of density in the renal shadow are often shown, especially where there is inspissated pus in cavities of the kidney, due in all probability to the

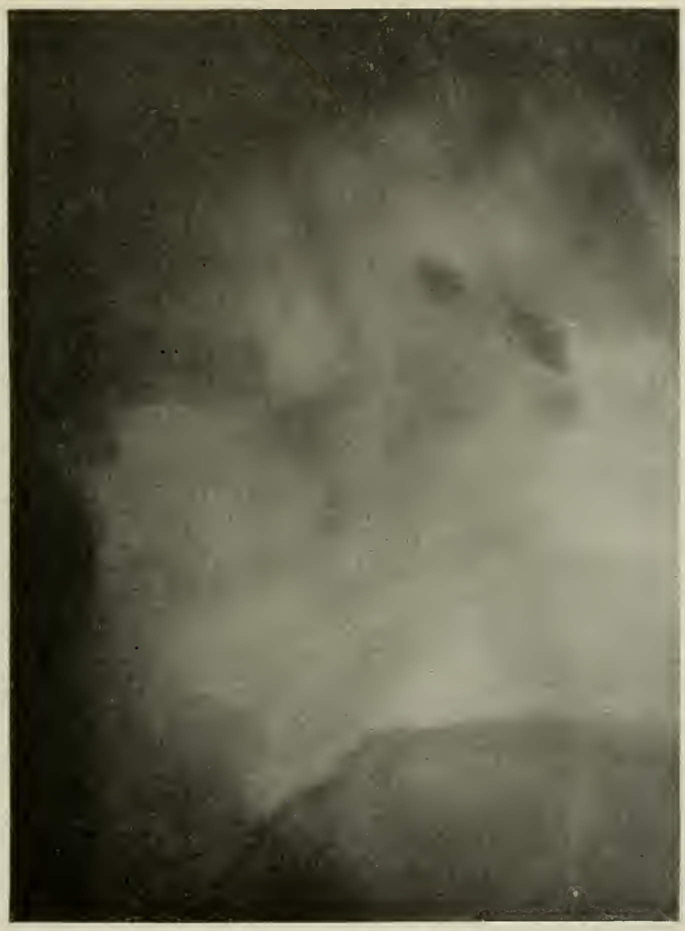

FIG. 18. STONES IN THE KIDNEY

presence of lime salts or other substances that will obstruct the ray. Of course, calculi are shown in some of these kidneys and ureters unless they are very small or of pure uric acid type.

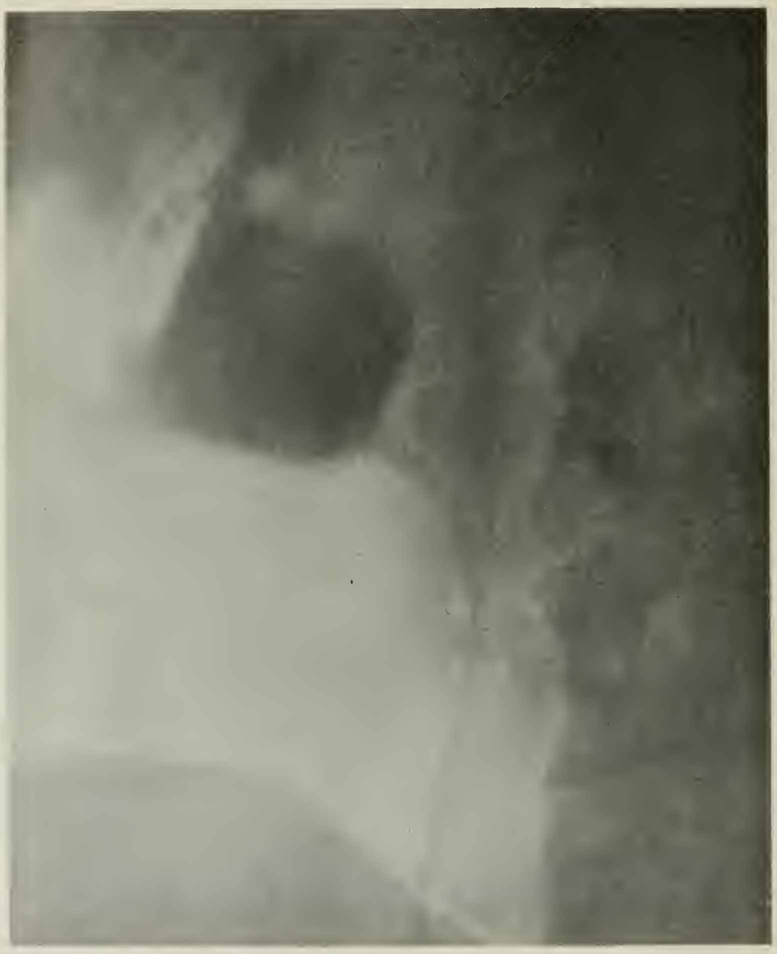

FIG. 19. SAME CASE AS FIG. 18
Note advanced grade of calculous pyo-nephrosis

The pyelogram is one of the greatest aids in making a final diagnosis and especially in determining the extent of destruction of the renal parenchyma. Sodium bromide seems to be the most innocuous substance so far advocated in this type of work and in most of the advanced cases is tolerated better than in the normal kidney. The absence of secretion in a kidney is no

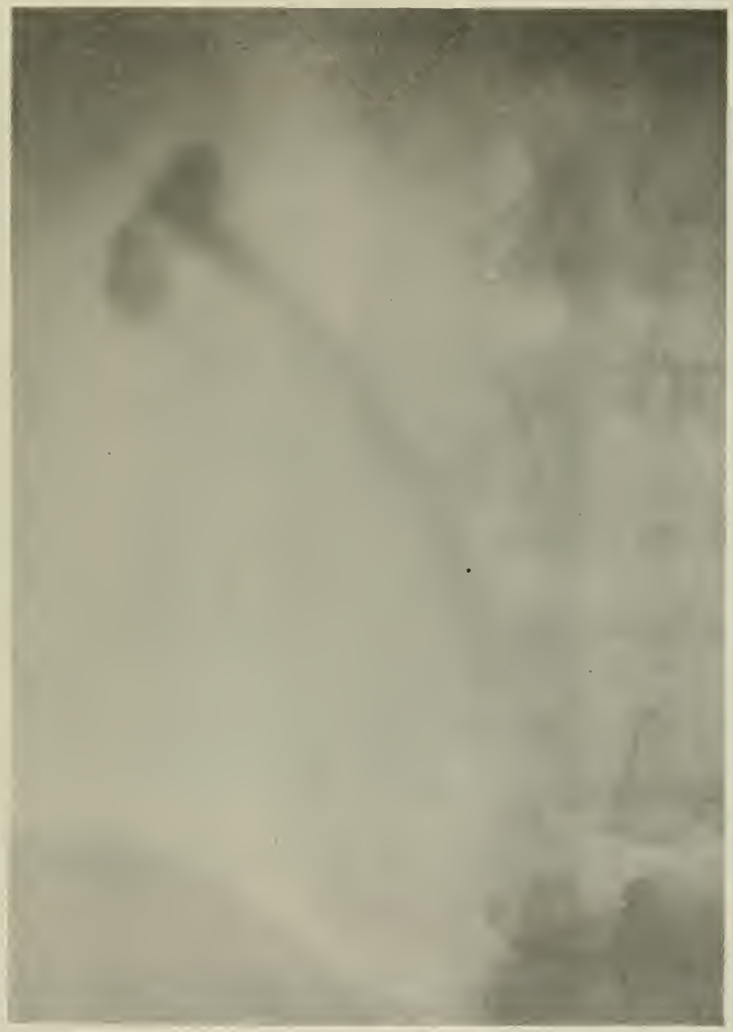

FIG. 20. STONE AT THE URETEROPELVIC JUNCTION, PREVENTING THE PYELOGRAPHIC MEDIUM FROM FILLING AN ENORMOUS SAC; NEPHRECTOMY; RECOVERY

contraindication to pyelography as in some of these cases a valve like formation at the ureteropelvic junction will allow the gentle introduction of the fluid into the kidney, although nothing may return at the time through the ureteral catheter. It seems wiser to be contented with a pyelogram made with twenty or thirty cubic centimeters of fluid in cases where large sacs are suspected than to inject large amounts as disagreeable results may occur.

DIFFERENTIAL DIAGNOSIS

After a diagnosis of renal inflammation has been made clinically the final diagnosis of pyonephrosis can be accurately made only by means of the pyelogram.

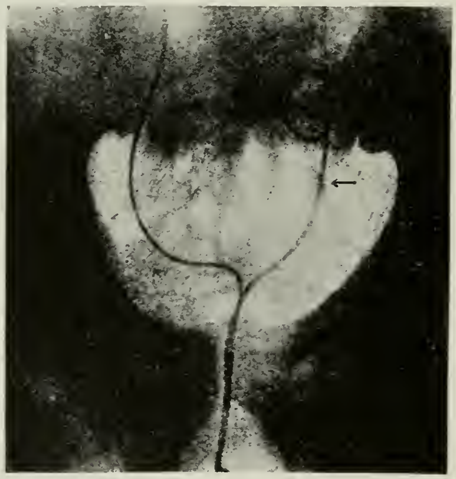

Fig. 21. Curious Complete Turn of Ureteric Catheter in Enormous Pyo-Ureter, Resulting from Stone in Pelvic Segment of Ureter; Enormous Pyonephrosis; Nephrectomy Recovery

The febrile group of cases offers at times considerable difficulty in diagnosis, especially when the urinary findings are not marked and when the pain in the loin is not a marked feature. Until some of these signs appear, the case is often treated for a long time for septicemia, or typhoid fever or malaria. In some cases of this sort, the firm tumor in the left loin has been mistaken for an enlarged spleen and the diagnosis of malaria considered to be strengthened by this sign.

Abdominal masses simulate pyonephrotic kidneys more often than pyonephrotic kidneys simulate other abdominal masses. When an anatomical diagnosis cannot be made clinically, a pyelogram of the kidney of that side may be made, and by outlining the mass topographically on the abdominal wall by means of lead plates, a differentiation may be made from kidney at least. The abdominal tumors that are most confusing are hydrops or empyema of the gall bladder, retroperitoneal sarcomata usually of glandular origin, tumors of the colon, enlarged hard spleens of Hodgkins disease or of malaria or of blood dyscrasia.

Fig. 22. Case Similar to Fig. 21; Nephrectomy; Recovery

Renal tumors, particularly hypernephromata, are not as a rule difficult to differentiate from pyonephroses; although some of them do run a febrile course, there is no pyuria. The pyelogram is of great assistance in most cases.

TREATMENT

Pelvic lavage has very little value except in selected cases. In fact it is generally contraindicated as soon as the pyelogram shows any great amount of tissue destruction (vide Simons, Lavage, etc.). In selected cases it may be of some value, for example in carrying pregnant women with pyonephrosis through the pregnancy and operating later (Caulk). Also in bilateral cases, particularly those in which there are stones on both sides, lavage and the retention ureteral catheter may be of value until a time favorable to nephrotomy has come.

Aside from the previously mentioned condition nephrotomy has no place except perhaps in single kidneys affected with pyonephrosis.

Partial nephrectomy has been employed in cases where the congenital arrangement of the pelvis allowed the development of partial pyonephrosis.

Nephrectomy by the lumbar route is the operation of choice in most cases.

REFERENCES

Albrecht, W.: Beitr. zur klin. Chir., l, 147, 1906.

Aschoff: Pathologische Anatomie. Jena, 1911.

Baehr, G.: Glomerular lesions of subacute bacterial endocarditis. Amer. Jour. Med. Sci., Philadelphia, 1912, N. S., cxliv, 327; and Jour. Exp. Med., New York, xv, 330.

Caulk, J. R.: Ureter catheter drainage in the treatment of renal infections (with special reference to the infected hydronephrosis complicating pregnancy). Section on G. U. Diseases A. M. A. 1914.

Cunningham, J. H., Jr.: Acute unilateral hematogenous infections of the kidney. Trans. Amer. Assoc. G. U. Surgeons, vol. vii, 1912.

Cunningham, J. H., Jr.: Acute unilateral hematogenous infections of the kidney. Section on G. U. Diseases, A. M. A., 1914.

Eisendrath, D. N., and Schultz, O. T.: Lymphogenous ascending infection of the urinary tract. Section on G. U. Diseases of the A. M. A., 1916.

GASKELL: On the changes in the glomeruli and arteries in inflammatory and arteriosclerotic kidney disease. Jour. of Path. Bacteriol. Cambridge, 1911, 12, xvi, 287.

KIDD, F.: Common infections of the kidneys. Oxford University Press, 1920.

LOEHLEIN: Med. Klin., Berlin, 1910, vi, 374.

SIMONS, I.: Lavage of the renal pelvis etc. Trans. Amer. Urol. Assoc., 1917.

SIMONS, I.: Bacterial Endocarditis (section on pathology of the kidney). Quart. Jour. Med. Apr. 1914, vol. vii, no. 27.

SCHNITZLER: Beitr. zur Kenntnis der latenten Microorganismen, Verhandlungen der deutschen Gesellschaft fuer Chir., 1899.

EXPERIMENTAL HYDRONEPHROSIS

THE FAILURE OF DIURESIS TO AFFECT ITS RATE OF DEVELOPMENT[1]

FRANK HINMAN and A. ELMER BELT

From the Hooper Foundation of Medical Research and the Department of Urology, University of California Medical School

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INTRODUCTION

The mechanism of hydronephrosis is unknown. It is inseparable from the problem of renal activity, and although many physiologists have attacked the latter through an experimental study of hydronephrosis, definite proof of the causes of the many interesting variations met with is still wanting. Brief mention of the many factors that might be expected to influence this mechanism will be left for the discussion. The purpose of this paper is the presentation of an experimental study of the influence of one of these possible factors, namely the rate of urinary excretion, upon the development of hydronephrosis.

The causes of an increase in the flow of urine are at best poorly understood. Renal diuresis has always been the stumbling-block of the many theories advanced in explanation of renal activity. The action of diuresis upon ureteral pressure is uncertain. A constant increase of the ureteral pressure would surely be expected to have an hastening effect upon hydronephrosis. Profuse diuresis from salines and urea have been observed by Cushny (8) and others occasionally to raise the maximal ureteral pressure to 130 mm. of mercury in one dog (Obniski (9)), when the average is about 50 to 70 mm. But all diuretics do not so act; neither do these two thus act uniformly. There are many technical difficulties and variations, too many to be discussed here. Irrespective of the theory in explanation of urinary secretion, can one look for an effect upon the development of hydronephrosis in those conditions influencing more or less continuously the amount of urine excreted. Or will certain types of diuresis only, as, for example, those following an increase of blood pressure, have an influence? There is a certain definite relation between the blood pressure and the ureteral pressure and here the kidney differs from secretory glands, in which secretory pressure is largely independent of blood pressure. But if it is conceivable that renal activity continues in a kidney of which the ureter is completely obstructed—and the formation of large fluid sacs would seem only thus possible—it would seem reasonable to expect that the production of greater activity through the use of diuretics or of relative inactivity through water starvation would result in an alteration of the usual picture.

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[1] Read April 21, 1922, at Atlantic City, before the American Urological Association.

Certain difficulties are immediately presented in contemplation of the investigation, the two greatest of which are the great variation and uncertainty in the mode of action of diuretics in general and the difficulty, in view of our ignorance of its mechanism, of having a proper control of simple hydronephrosis for comparison.

Previous experimental work with large white rats has given us entire confidence in the uniform and progressive development of hydronephrosis with complete ureteral obstruction. Partial obstruction would not be possible of accurate control in any animal and complete obstruction in larger animals gives variations and occasionally, as in the cat or dog, leads to primary atrophy. We have now doubly tied and divided the ureter in over 300 rats and have yet to see the occurrence of a primary atrophy. In these animals the degree of hydronephrosis is uniformly proportional, grossly, to the duration of the obstruction relative to the age and weight inequalities. Microscopically slight differences are due to the impossibility of having for comparison sections from exactly similar portions of the hydronephrotic kidneys. The degree of hydronephrosis of each control animal is readily classified in conformity to the period of the obstruction, and there is no overlapping nor exceptions. The four-day periods may differ somewhat among themselves but differ entirely from the seven-day kidneys, and the seven from the fourteen, and so on. As a group each period is distinct. The rat from the standpoint of control is therefore ideal for the experimental testing of the action of diuresis upon the development of hydronephrosis.

Its choice, however, was unfortunate in that practically no work has been done on this animal with the usual diuretics. Standardization of their action in so small an animal would be tedious and difficult and has not been attempted. For this reason we have chosen a rather complete variety of diuretics and have tried to give a maximal dose of each. On this account our mortality under diuresis, particularly with digitalis and diuretin, has been high, but in order not to vitiate our results only those specimens of animals in good health when sacrificed at the desired period have been used. By observation we know that an enormous increase in the urine output has been kept up daily for the periods desired. Daily intraperitoneal injection of 25 cc. of fluid, more than one-tenth of the body weight, would alone insure this. For purposes of comparison the animals were run in the following series:

1. Control series; free access to food and water.
2. Fluid limitation series; free access to dry food but water given in minimal quantities in moist bread.
3. Urea diuresis series; free access to food and water and the daily intraperitoneal injections of 25 cc. of a 1 per cent urea solution (0.25 gram urea).
4. Salt diuresis series; free access to food and water and the daily intraperitoneal injections of 25 cc. of a 2 per cent solution of sodium chloride (0.5 gram NaCl).
5. Diuretin diuresis series; free access to food and water and daily intraperitoneal injections of 25 cc. of a 0.2 per cent solution of diuretin (0.05 gram diuretin).
6. Digitalis diuresis series; free access to food and water and the intraperitoneal injection of 4.5 cc. of digitalis infusion in 25 cc. of water on alternate days. (Fresh infusion made every third day (Eggleston) by taking 15 grams of the dried leaves and pouring over them 1000 cc. of boiling water.)

EXPERIMENTAL DATA

Procedure

Large white rats of uniform age and weight (average, 200 grams) have been used.[2] Under ether narcosis and surgical asepsis the left ureter was doubly ligated with silk ligatures, just above the bladder, and divided between them through a midline suprapubic incision. The operated animals were carefully labeled by the ear-punch method and segregated for study into the 6 groups mentioned above.

I. The Control Series

The characteristically uniform increase in size of hydronephrosis in the rat with unilateral ureteral obstruction is demonstrated in table 1. The measurements of length, width and depth were made with a micrometer, as shown in figure 1. There is a marked slowing of the rate of increase by the end of the sixth week—42 days (see also fig. 2), but enlargement continues up to 365 days, when the sac holds about 12 cc. of smoky fluid, usually containing many red blood cells. We have no observa-

TABLE 1

Measurements showing uniform increase in size of hydronephrotic kidney in rats after total ligation of left ureter

DURATION	NUMBER OF RATS REPRESENTED	AVERAGE WEIGHT OF RATS	AVERAGE KIDNEY MEASUREMENTS		
			Length	Width	Depth.
days		*grams*	*cm.*	*cm.*	*cm.*
0	30	194	1.63	0.82	1.00
4	9	210	1.84	1.02	1.04
8	14	214	2.15	1.12	1.15
14	20	229	2.35	1.50	1.31
28	21	243	2.55	1.68	1.43
42	17	235	2.72	1.78	1.64
56	14	230	2.71	1.92	1.71
365	5	260	3.51	2.35	2.16

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[2] We are indebted to Dr. Herbert C. Evans for his generosity in furnishing us with young adult and healthy rats of uniform breed.

tions of longer duration than one year, but further enlargement would not seem possible in view of the mere connective tissue sac then present. Similar weight curves of hydronephrosis in

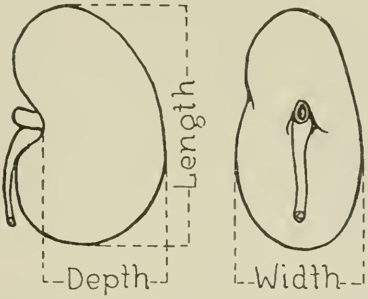

Fig. 1. Diagram to Show Method of Measurement of Kidneys for Depth, Length and Width

In measuring the depth extra-renal pelvic dilatation is disregarded.

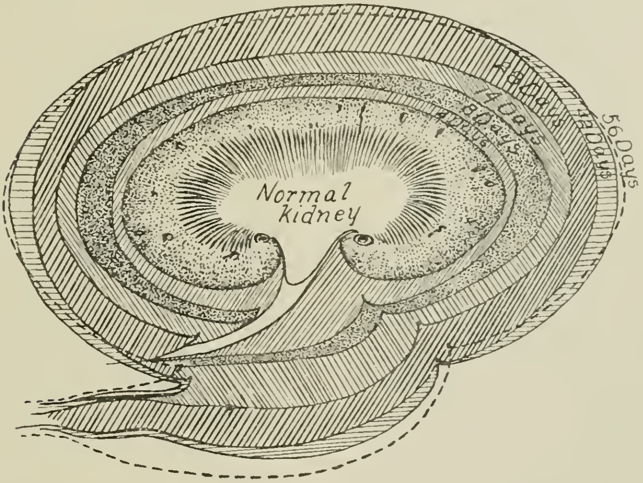

Fig. 2. Composite Drawing to Represent the Progressive Increase in Size of the Kidney for the Different Periods of Complete Ureteral Obstruction

rabbits, published by Holste (10), Ponfick (11), and Winkler (12), ran closely parallel to these for rats. The uniformly progressive nature of the hydronephrotic atrophy is well demon-

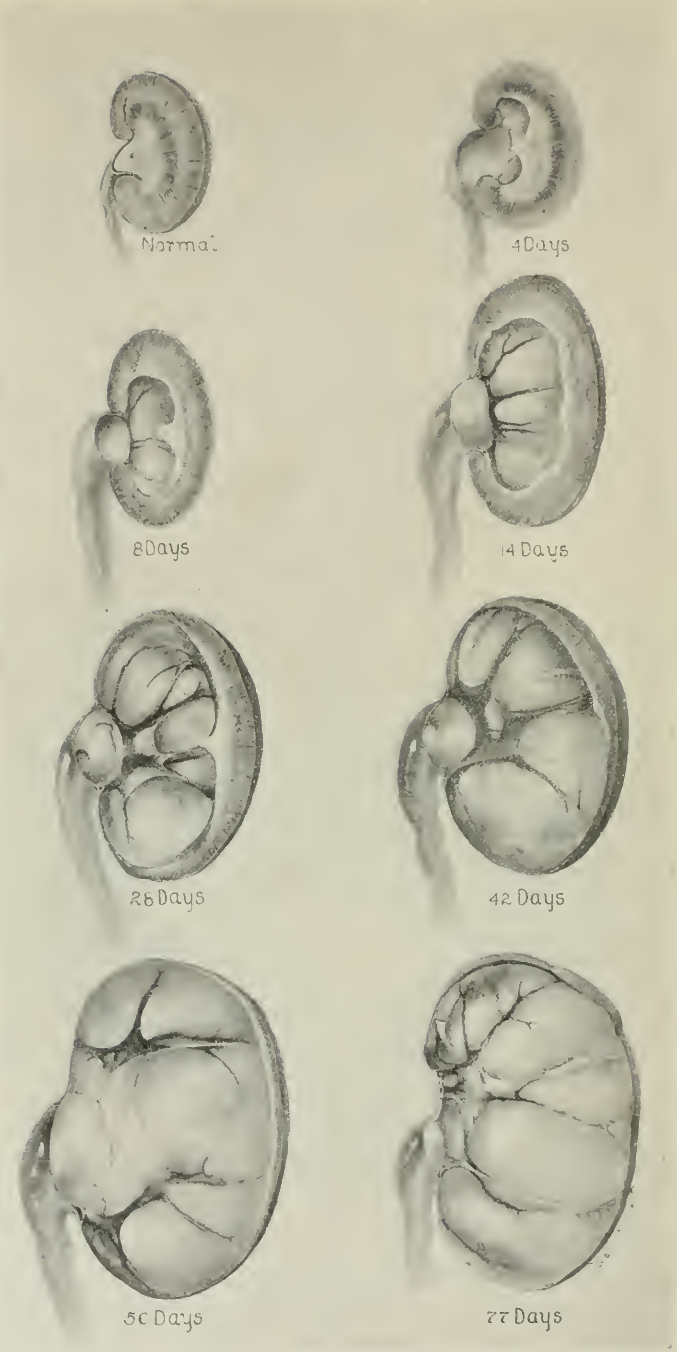

Fig. 3. Drawings of Representative Hydronephrotic Rat Kidneys Cut Sagitally for the Different Periods of Obstruction

Compare with the drawings of similar specimens but cut in cross and coronal section, shown in figures 4 and 5. The parenchymal atrophy is seen to involve the lateral portions of the kidneys first (8 to 14 days), the polar areas next (28 days) and the median sagittal portion last (56 days). See figure 13.

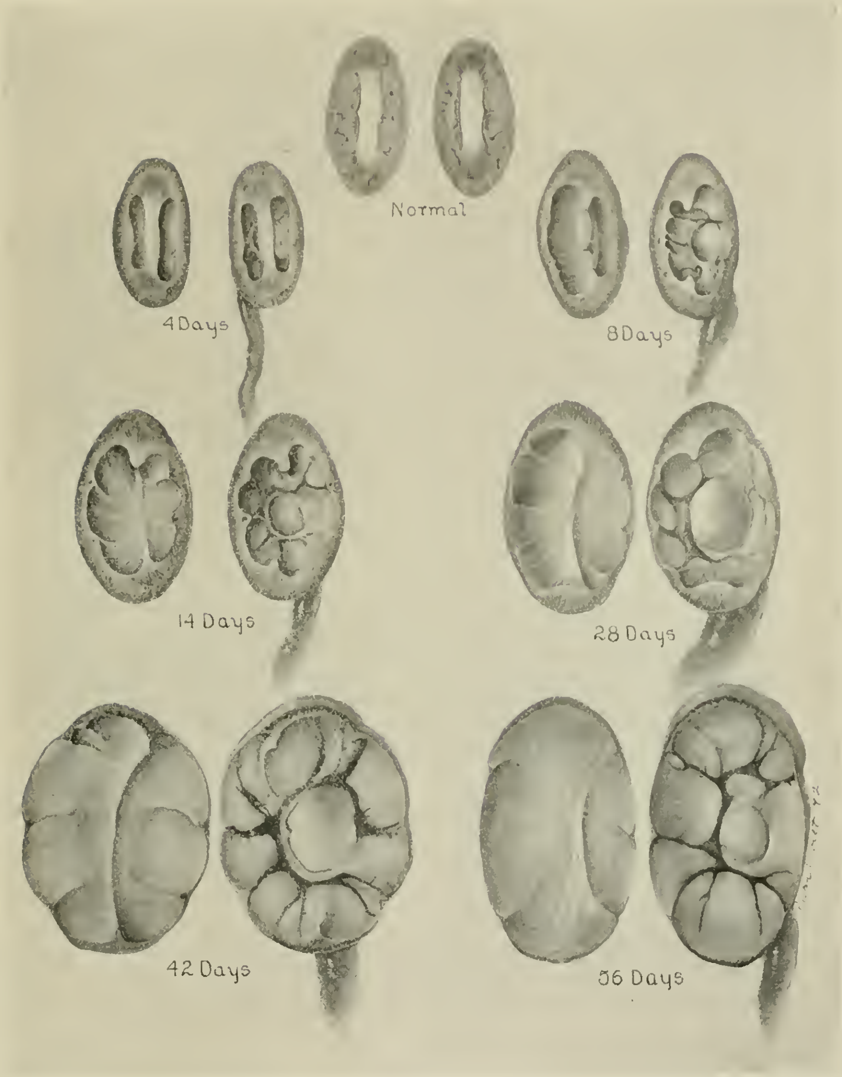

Fig. 4. Drawings of Representative Specimens of Rat Hydronephrosis Cut in Coronal Section

Compare with figures 3 and 5, also figure 13.

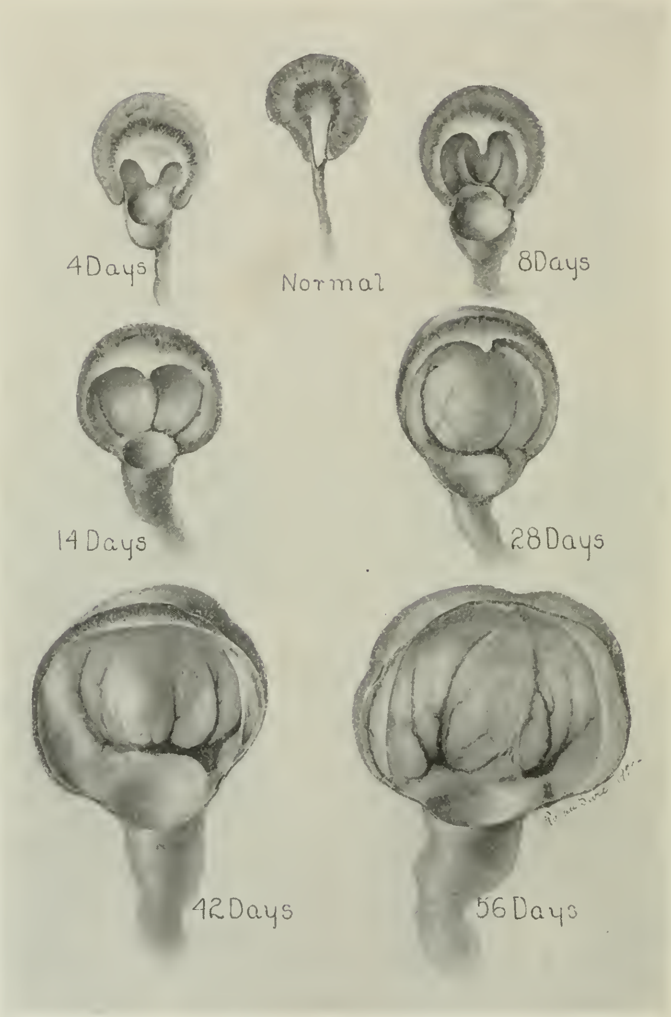

Fig. 5. Drawings of Representative Specimens of Rat Hydronephrosis of Increasing Periods of Duration, Cut in Cross Section

Compare with figures 3 and 4 and with the photograph of the specimens themselves, shown in figure 13.

strated by these measurements and is illustrated in figures 3, 4 and 5 after sagittal, coronal and cross section, respectively. (See also actual photograph of specimens in figure 13.) It will be seen that the pressure atrophy progresses in the lateral portions of the kidney first, then gradually involves both poles, and that the median sagittal portion is unusually resistant.

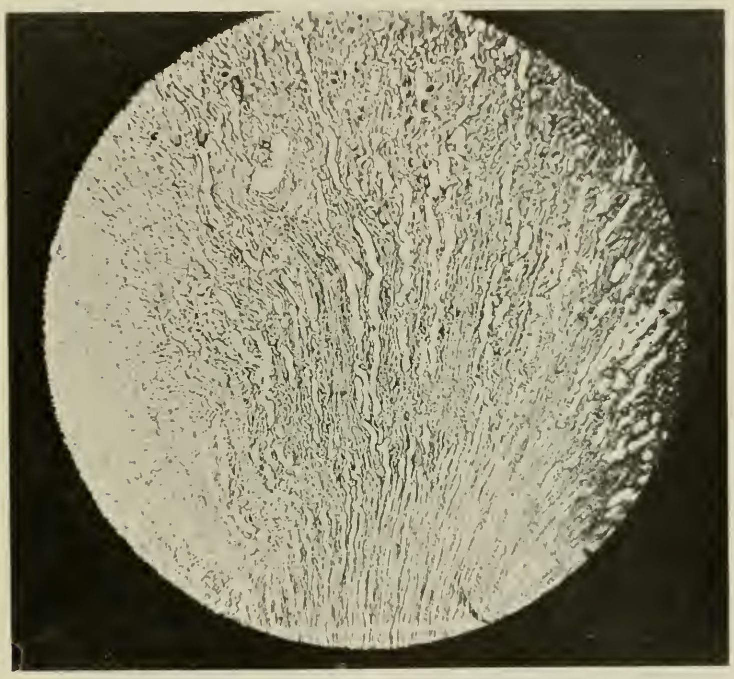

Fig. 6. Photomicrograph (Low Power) of Rat Hydronephrosis of 4 Days' Duration, Showing the Marked Tubular Dilatation Which is Most Pronounced in the Collecting Tubules and Least Noticeable in the Convoluted Tubules

The histologic changes in the rat have been described by one of us elsewhere (13). In general, there is a characteristic group distribution of the changes with areas of tubular collapse, and finally of tubular atrophy and necrosis with connective tissue sclerosis variously predominating, and there is not a uniform mass involvement. These group changes are most marked first in the lateral, then in the polar, and finally in the median sagittal portions. Collecting and straight tubules show the most marked dilatation (fig. 6), and convoluted tubules are predominatingly collapsed (figs. 7 and 8). The axes of dilated tubules in the earlier periods of obstruction are at right angles to the kidney surface (figs. 6 and 9), but after 28 days they take a course almost parallel to its surface (figs. 10 and 11). Glomeruli are surprisingly resistant and are crowded together near the

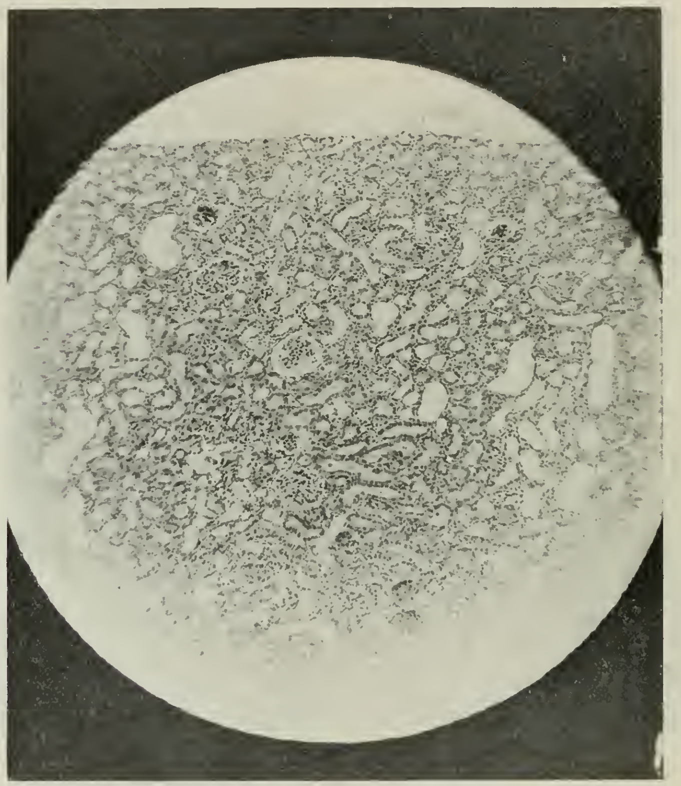

Fig. 7. Photomicrograph (Low Power) of Rat Hydronephrosis of 8 Days' Duration

Tubular dilatation is marked except for areas of convoluted tubules which are collapsed. There is dilatation of some Bowman's spaces.

surface and are often well preserved even after 95 days' obstruction and almost complete disappearance of tubules (fig. 12). One wonders how their contents can find an outlet through the dense connective tissue separating them from the pelvis (fig. 12), and yet there must be an outlet even beyond the period of one year's obstruction. The sequence of the alterations are well illustrated in the reproduced photomicrographs (figs. 6 to 12) and described in the legends.

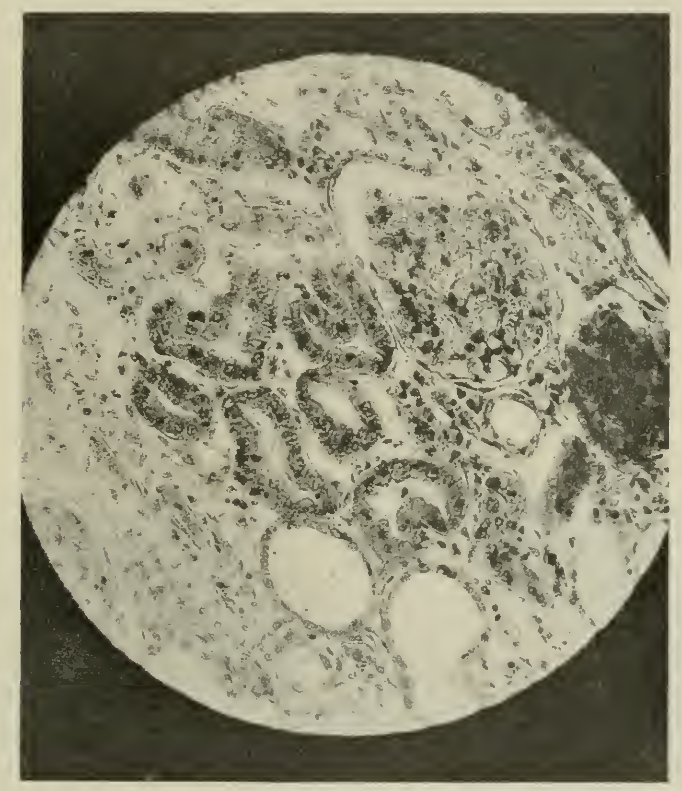

FIG. 8. PHOTOMICROGRAPH (HIGH POWER) OF AN AREA OF FIGURE 7, OF AN 8 DAYS' RAT HYDRONEPHROSIS WHICH SHOWS THE DIFFERENCE OF REACTION OF CONVOLUTED TUBULES AND OF OTHER TUBULAR PORTIONS TO BACK PRESSURE
VITUARITOL STAIN

The convoluted tubules are collapsed or only slightly dilated.

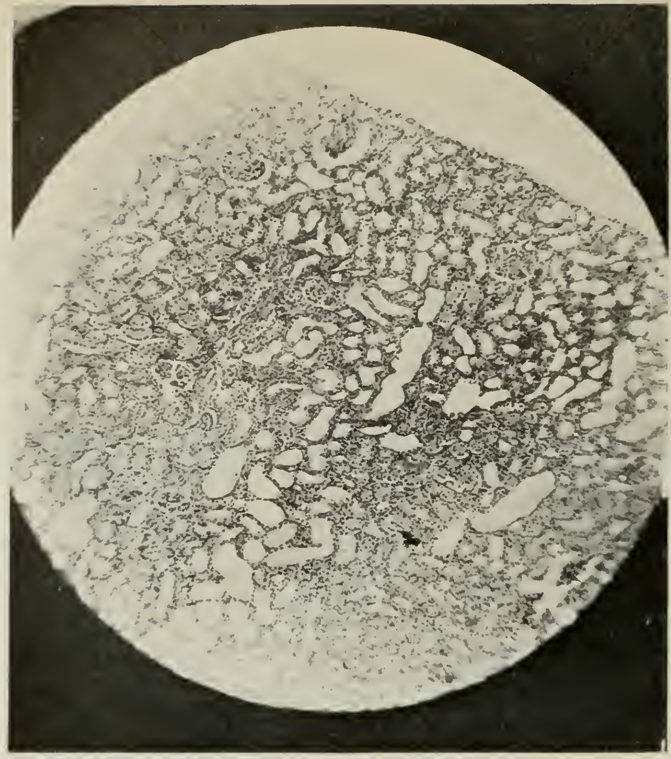

Fig. 9. Photomicrograph (Low Power) of 14 Days' Rat Hydronephrosis.

There is some dilatation with epithelial flattening of the convoluted tubules, with tendency to group-area arrangement of tubular dilatation and atrophy and of tubular preservation without much atrophy. The long axes of dilated tubules are predominatingly at right angles to the kidney surface.

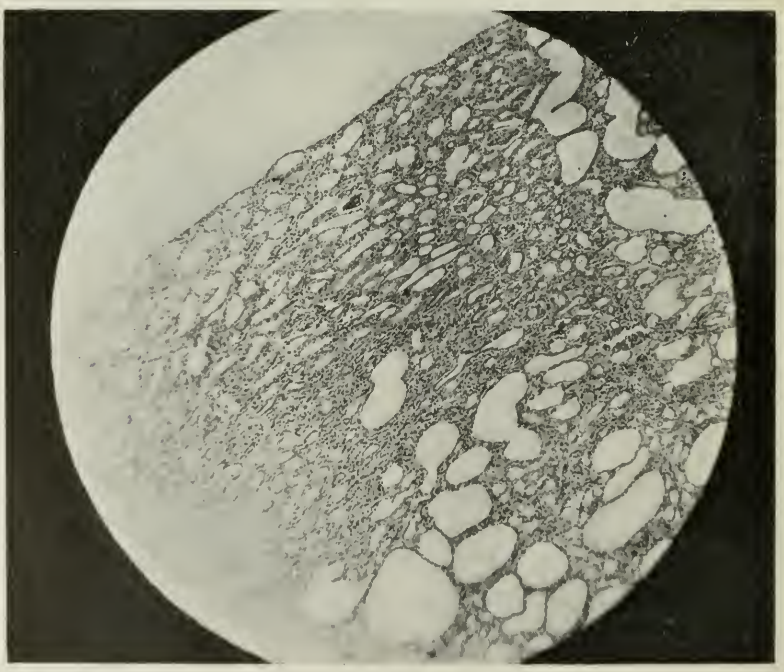

Fig. 10. Photomicrograph (Low Power) of a Rat Hydronephrosis of 28 Days' Duration, over an Area of Relative Tubular Preservation

Remarkable tubular dilatation surrounds the area. There is a distinct tendency for the axes of tubules to run parallel to the kidney surface. A few convoluted tubules show little if any dilatation.

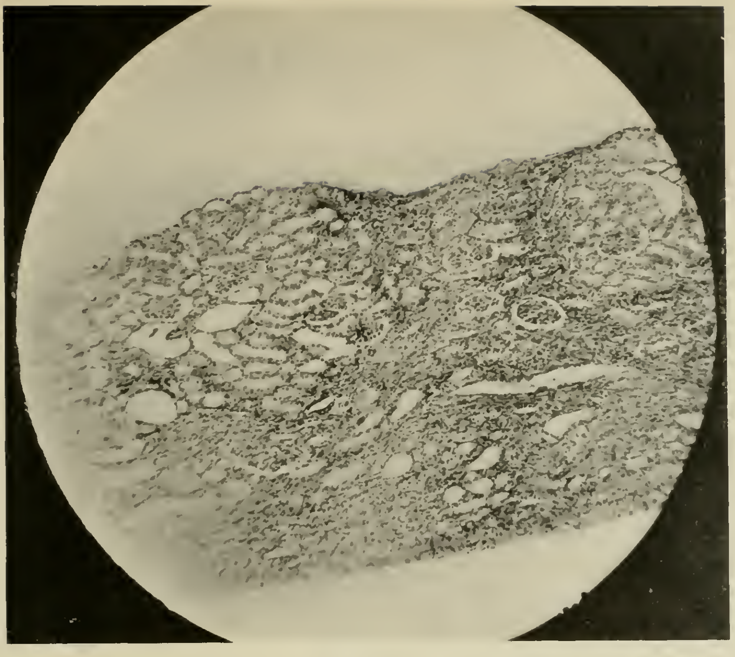

Fig. 11. Photomicrograph (Low Power) of a Rat Hydronephrosis of a 42 Days' Duration

The renal parenchyma has become a thin rim of tissue with a distinct nodulation. Marked atrophied and sclerosed areas separate a few nodules of less marked tubular destruction. Two such nodules are seen in the illustration. There is marked round cell infiltration and connective tissue substitution.

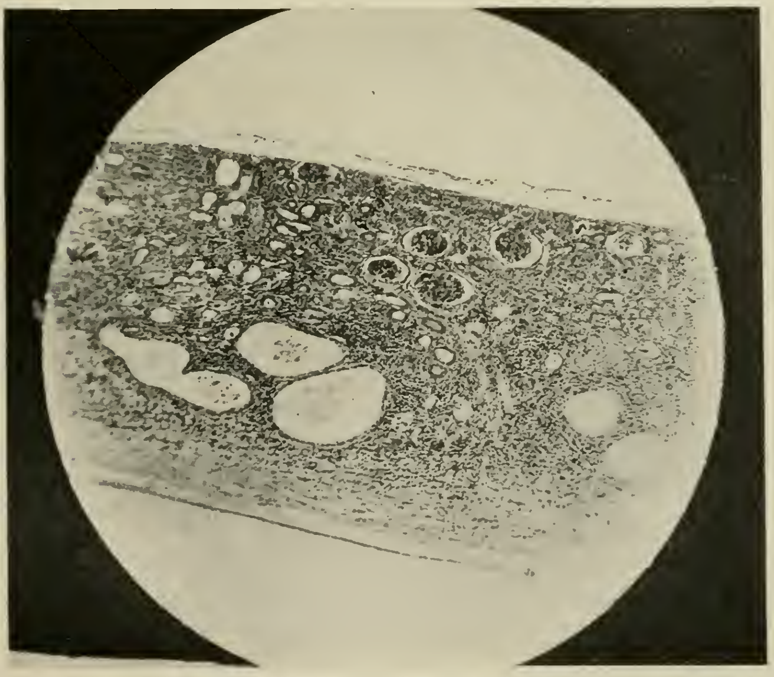

Fig. 12. Photomicrograph (Low Power) of a 56 Days' Hydronephrosis

A few groups of a small number of atrophied tubules remain. Glomeruli are fairly well preserved and are crowded together near the surface. It is difficult to see how the contents of these glomeruli gain access to the pelvis through this dense connective tissue rim.

TAB

Hydronephrotic left kidneys of rats follow

SERIES PROCEDURE	4 DAYS					8 DAYS				
	Rat number	Weight	Length	Width	Depth	Rat number	Weight	Length	Width	Depth
Control: Food and water freely accessible in cage throughout period	18	240	2.00	1.10	1.20					
Average		240	2.00	1.10	1.20					
Water starvation: Free access to dry food. Water given in minimal quantities in moist bread	35	245	1.80	1.08	1.10	36	210	2.65	1.58	1.37
						41	185	2.15	1.40	1.30
						45	244	2.38	1.23	1.12
						66		2.00	1.10	1.00
						67		2.10	1.20	1.20
Average		245	1.80	1.08	1.10		213	2.26	1.30	1.20
Saline diuresis: 2 per cent saline 25 cc. intraperitoneally daily. Free access to food and water										
Average										
Urea diuresis: 25 grams urea in 25 cc. water intraperitoneally daily. Free access to food and water	19	208	1.85	1.05	1.15	28	195	2.00	1.10	1.00
	21	210	1.80	1.00	1.00	29	210	2.13	1.22	1.50
Average		209	1.82	1.02	1.08		202	2.07	1.16	1.03
Diuretin diuresis: 0.05 gram diuretin in 25 cc. water daily intraperitoneally. Free access to food and water	72	240	1.85	1.00	1.00	74	250	2.30	1.20	1.10
	73	245	1.85	1.05	1.05	75	240	2.00	0.80	1.10
						76	245	2.20	1.10	1.10
						77	250	2.10	1.10	1.20
Average		242	1.85	1.02	1.02		246	2.30	1.05	1.12
Digitalis diuresis: 4.5 cc. of digitalis infusion in 25 cc. water intraperitoneally daily. Free access to food and water	49	156	1.85	0.87	0.97	52	170	2.00	1.02	1.06
	50	178	1.75	1.00	0.90	53	200	2.13	1.19	1.01
	51	170	1.80	1.06	1.00	54	170	2.00	1.02	1.06
Average		168	1.80	0.97	0.94		180	2.06	1.08	1.04
General average		210	1.84	1.02	1.04		214	2.15	1.12	1.15

LE 2

ing complete ligation of left ureter at bladder

14 DAYS					28 DAYS					42 DAYS					56 DAYS				
Rat number	Weight	Length	Width	Depth	Rat number	Weight	Length	Width	Depth	Rat number	Weight	Length	Width	Depth	Rat number	Weight	Length	Width	Depth
37	240	2.40	1.30	1.20	25	240	2.60	1.60	1.90	13	246	2.50	1.40	1.30	6	243	2.20	1.50	1.80
38	242	2.30	1.50	1.20	26	243	2.50	1.80	1.60	15	240	2.80	1.50	1.90	88	238	2.30	1.55	0.95
39	243	2.50	1.40	1.30	27	252	2.70	2.00	1.70	11	320	2.35	1.55	1.15	89	237	2.65	1.63	1.60
4	150	2.60	1.30	1.20	8	327	2.70	1.80	1.50	14	175	2.80	1.75	1.60					
5	250	2.00	1.30	0.84	9	243	3.00	1.80	1.70										
	225	2.36	1.36	1.15		261	2.70	1.80	1.68		245	2.61	1.55	1.49		239	2.38	1.56	1.45
40	243	2.10	1.00	1.25	22	230	2.10	1.70	1.30	23	240	2.50	1.70	1.40	24	233	2.40	1.50	1.30
42	245	2.40	1.40	1.50	68	243	2.70	1.80	1.20	90	242	2.80	1.80	1.54	70	250	3.30	2.20	2.10
7	250	2.30	1.45	1.45	69	256	2.70	1.70	1.60	91	239				71	250	2.40	1.80	1.40
88		2.50	1.50	1.35															
	246	2.33	1.33	1.39		243	2.50	1.73	1.37		240	2.65	1.75	1.47		244	2.70	1.83	1.60
92	200	2.20	1.30	1.10	95	180	2.75	2.00	1.53	86	261	2.90	2.10	1.80	98	183	2.87	1.87	1.50
93	170	2.00	1.10	1.20	96	280	2.70	1.76	1.40						87	186	3.05	1.80	1.70
94	151	2.05	1.12	1.10	97	287	2.50	1.71	1.34										
					84	169	2.70	1.70	1.55										
					85	270	2.50	1.60	1.24										
	174	2.08	1.17	1.13		237	2.63	1.75	1.41		261	2.90	2.10	1.80		184	2.96	1.83	1.60
46	237	2.30	1.30	1.30	34	200	2.50	1.70	1.30	16	208	2.50	1.50	1.80	1	225	2.90	2.15	2.16
47	220	2.90	2.10	1.90	30	254	2.50	1.55	1.42	17	228	2.85	1.60	1.80	99	215	3.40	2.50	2.10
48	201	2.30	1.50	1.40															
	219	2.50	1.63	1.53		227	2.50	1.63	1.36		218	2.62	1.55	1.80		220	3.15	2.32	2.13
44	220	2.25	1.30	1.30	31	240	2.60	1.70	1.40	12	195	2.25	2.00	1.65	10	278	2.90	1.70	1.50
78	270	2.38	1.50	1.30	32	250	2.20		1.30	80	245	2.40	1.60	1.30	83	280	3.10	2.50	1.80
					33	240	2.60	1.70	1.40	81	250	3.20	2.40	2.04					
					79	255	2.40	1.40	1.25	82	250	3.10	2.00	2.00					
	245	2.32	1.40	1.30		246	2.45	1.60	1.34		235	2.74	2.00	1.75		279	3.00	2.10	1.65
55	280	2.40	1.50	1.30	58	220	2.20	1.40	1.27	60	230	3.00	1.80	2.00	64	180	3.50	2.21	2.21
56	290	2.55	1.75	1.55	59	228	2.35	1.25	1.15	61	222	2.50	1.70	1.30	65	217	2.95	2.02	1.85
57	260	2.60	1.71	1.62						62	200	3.10	2.06	1.65					
	277	2.51	1.65	1.49		224	2.27	1.33	1.21		217	2.87	1.85	1.65		198	3.22	2.11	2.03
	229	2.35	1.42	1.32		243	2.55	1.68	1.43		235	2.72	1.78	1.64		230	2.71	1.92	1.71

II. The Series with Oliguria and Polyuria

The results obtained with water starvation and diuresis due to salt, urea, diuretin and digitalis are so uniform that separate discussion of them is unnecessary. The detailed measurements of all specimens are given in table 2. Examination of these figures reveals no size variation between groups greater than that found between individual specimens of the control group, and these slight variations are largely nullified when proportioned to the animals' weight, as is well shown in the following summary of the 28-day groups:

		WEIGHT	LENGTH	WIDTH	DEPTH
I	Control	261	2.70	1.80	1.68
II	Water starvation	243	2.50	1.73	1.37
III	Salt	237	2.63	1.75	1.41
IV	Urea	227	2.50	1.63	1.36
V	Diuretin	246	2.45	1.60	1.34
VI	Digitalis	224	2.27	1.33	1.21

In Figure 13 is reproduced a photograph of an average series of each group, which also demonstrates the uniform nature of the enlargement throughout.

Unfortunately we cannot present experimental controls to show how the various drugs produced diuresis. Our evidence of diuresis lies in the constant observation that the cages of the animals receiving the injections were found soaking wet in a very brief period, while the cages of animals upon limited water and of the control series were constantly very dry in comparison. It was noted, furthermore, that the rats receiving urea, salt, diuretin and digitalis consumed much more of the water available in their cages than was consumed by animals of the control series. It is therefore certain that with urea, salt, diuretin and digitalis a profuse diuresis was produced.

The infusion of digitalis was selected for use because of the therapeutic preference for it as a diuretic (Janeway (14)) and its use on alternate days seems justified because of its known cumulative action (Hatcher (15), von der Heide (16)). Daily injections were found to cause, after five or six days, severe diarrhoea, necessitating a delay of a few days, and larger doses than 4.5 cc. produced a state of nervous intoxication in which the rat would react violently to sudden noises and other such stimuli, even going into strychnine-like swoons. That diuresis was produced in this group is shown by the fact that the cages of these animals were as wet as those of the animals having urea, salt and diuretin diuresis; but whether this diuresis was caused by digitalis acting in one or the other of the following four ways:

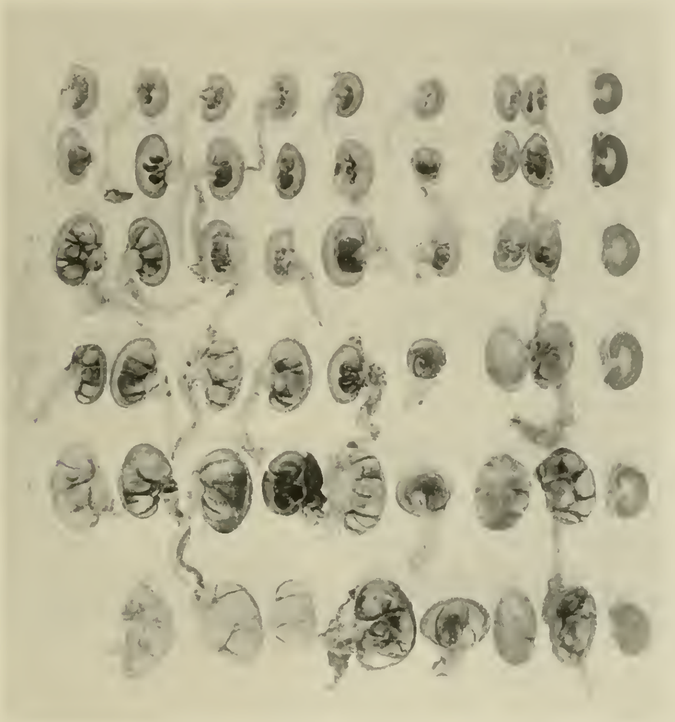

Fig. 13. Photograph of Representative Specimens of Each Series Arranged in Parallel Periods of Obstruction

When proportioned to the weight of the animals there is little if any difference between specimens of the same period of the various groups. There is a definitely proportional amount of hydronephrotic atrophy for all, even for those showing slight differences in the amount of dilatation.

by increasing the blood pressure, by increasing the volume and altering the composition of the blood, by emptying distended venous radicles so as to lessen the resistance opposed to secretion or by directly stimulating the secretory cells of the kidney to greater activity (Lauder Brunton (17)), or was simply the result of an increased fluid intake, we are unable to say.

SUMMARY

In each of 95 young adult white rats the left ureter has been doubly ligated and completely severed just above the bladder. Following this operation the rats have been placed on a uniform diet of dry bread and grain and divided into six groups. One was allowed free access to water, another was given as little water as possible in moist bread compatible with life, and the other four groups were subjected to profuse diuresis, each getting 25 cc. of water intraperitoneally daily, and with this salt, urea, diuretin and digitalis in maximal doses, respectively. Rats in each of the six groups have been sacrificed under ether after 4, 8, 14, 28, 42 and 56 days. The measurements of the hydronephrotic kidneys of these animals show a uniform increase in size for each increasing period of ureteral obstruction. There is no variation between groups of each period greater than that occurring among the individual specimens of the control group, and this slight variation is proportional to differences in body size.

DISCUSSION

The unique nature of hydronephrosis renders a study of its mechanism unusually interesting and one inseparable from renal function. Explanation of the occasional variations in the condition itself is of interest. Why the occasional development of primary atrophy after complete ureteral obstruction in some animals and never in others and why does it never follow a partial block in any? The difference in the type of hydronephrosis that follows a complete and an incomplete obstruction is well known. What is its true explanation? The effect of blood pressure and of blood flow, of venous stasis or arterial stasis as influenced by the vascular arrangement relative to the pelvic and tubular are pertinent problems. The exact influence of these anatomical and mechanical factors upon secretory or ureteral pressure which produces the dilatation and pressure atrophy, and the secondary effect of both of these upon the filtering membrane of the glomerulus, upon the vital activity of tubular reabsorption, upon the osmotic resistance of fluid in the tubules and the rate of tubular flow must all be taken into account. The significance of the development or not of a collateral capsular circulation and the little understood but frequently observed occurrence of direct venous reabsorption from the pelvis may be circulatory factors of moment. The virulence, type and location of infection might produce variations, and the question of an occasional difference in the nervous influences affecting renal activity deserves consideration. These many and various factors emphasize its apparent complexity and little help is gained by correlation with theories of renal activity.

Any theory presupposing a purely secretory activity in the formation of the urine falls short at the very beginning by the lack of an analogy in other glands indisputably secretory.

Reasoning from gland physiology one would expect primary atrophy invariably to follow complete ureteral obstruction. Charcot and Gomboult (1), in 1878, experimentally demonstrated the difference between the kidney and other glands by the production in the guinea pig of a large hydronephrosis upon ligature of the ureter, whereas cirrhous atrophy with icterus followed ligature of the bile duct. The liver and kidney are organs quite different in structure and function and if the effect of duct obstruction in them were similar it would be surprising. But Arnozan and Voillard (2), in 1881, recorded atrophy of the parotid gland in two instances respectively of 13 and 30 days' obstruction by ligature of the duct of Stenson. The ducts themselves were found distended with normal looking saliva; many of the acini were dilated and their cells flattened in evidence of back pressure. There was epithelial desquamation, marked periglandular connective tissue sclerosis, and the obstructed glands weighed less than those on the opposite side, but nothing at all analogous to the pelvic dilatation and renal atrophy of hydronephrosis. Claisse and Dupre (3) and others have since verified these findings with respect to the parotid gland. Arnozan and Voillard also studied the effect of complete obstruction of the canal of Wirsung. The digestive action of the pancreatic secretion so hastens sclerosis that it was as far advanced in the pancreas on the third day as it was on the thirtieth in the parotid. Opie (4), while confirming these findings, observed the occurrence of small cysts in the pancreas which are interpreted by him as evidence of an intermittent type of obstruction, and both Dupre (5) and Lahousse (6) note similar pictures in the liver after bile duct obstruction. These retention cysts have a certain similarity to hydronephrosis, as pointed out by Albarron (7), in that the pressure of secretion causes a dilation of the glandular lumina, with flattening and desquamation of their preserved epithelial lining. The cyst-like accumulations in the parotid, pancreas or liver, the duct and acinal dilation, and the rapid sclerotic atrophy following these initial dilatations seem a far-fetched analogy to the progressive development of the immense fluid sacs and the gradual pressure atrophy of the renal parenchyma as seen in hydronephrosis.

Simple physical processes are likewise inadequate in explanation. No one would attempt to explain the many facts of urine excretion by filtration alone, and anyway, while mechanical filtration might explain to the satisfaction of some the formation of an hydronephrosis upon partial obstruction of the ureter, it cannot be regarded even by them as sufficient to explain the complete hydronephrotic atrophy and the huge sacs that develop after a complete ureteral block. The idea of glomerular filtration plus tubular diffusion (Ludwig) is equally unsatisfactory. While the modern theory (Cushny), that of glomerular filtration and tubular reabsorption, offers the most reasonable basis of explanation of the mechanism of hydronephrosis, there still remain many points needing explanation. Filtration may furnish the force to maintain intra-pelvic and ureteral pressure. and reabsorption in the tubules, by relieving this pressure, may thus enable a continuation of the action of this force so that pressure atrophy of the renal parenchyma with pelvic dilatation is the result, but there is no definite proof of this.

It would be profitless, however attractive, to discuss in relation to the modern theory the various theoretical aspects of the experiments with water starvation and of those with attempted salt, urea, diuretin and digitalis diuresis. This would be justified if we had knowledge as to the exact mode of action of the different drugs in producing diuresis. The uniform development of hydronephrosis, irrespective of a scant or a free flow of urine, can be interpreted so variously and in conformity to all individual predilections in theory as to give no definite proof of any, so that while the conclusion from the experimental study is quite definite, it is yet definitely limited.

CONCLUSION

Neither profuse polyuria nor marked oliguria influences in any way the usual course of development of hydronephrosis in white rats after complete ureteral obstruction.

REFERENCES

(1) Charcot et Gomboult: Prog. Méd., 1878, p. 82.
(2) Arnozan et Voillard: Compt. rend. de la Soc. de Biol., 1881, iii, 284–291.
(3) Claisse et Dupre: Arch. de Méd. Exper. et d'Anat. Path., 1894, vi, 41–74 and 251–277.
(4) Opie: Diseases of the Pancreas. 1910.
(5) Dupre: Thése de Paris, 1891, p. 117.
(6) Lahousse: Arch. de Biol., 1887.
(7) Albarron: Semaine Méd., 1894, xiv, 43–45.
(8) Cushny: J. Physiol., 1902, xxviii, 431–447.
(9) Obniski: Centralbl. f. Physiol., 1907, xxi, 548.
(10) Holste: Inaug. Dissert. Göttingen, 1888.
(11) Ponfick: Beitr. z. Path. Anat. u.z. allg. Path., 1910, xix, 12[illegible].
(12) Winkler-Posen: Verhandl. d. deutsch. Path. Gesellsch, 1912, xv, 216.
(13) Hinman: Jour. of Urol., 1919, iii, 147.
(14) Janeway: Arch. Int. Med., 1914, xiii, 360.
(15) Hotcher: Arch. Int. Med., 1912, x, 268.
(16) Van der Heide: Arch. f. exp. Path. u. Pharm., 1885, xix, 127.
(17) Brunton: Therapeutics of the Circ., Phila., 1908, p. 152.

DISCUSSION

Dr. R. Dellinger Barney, Boston: I wish to congratulate Dr. Hinman on what he has done. I think it is a splendid piece of work. I cannot add anything of value to what Dr. Hinman has said for my work was not so far-reaching as his. My work was done largely on dogs and many of those dogs were kept alive for a year and no infection of the kidney occurred. At the time the dog was sacrificed the urine was sterile to culture. I did lose one or two animals but this was exceptional. In several of the animals, dogs, rabbits and guinea pigs, it was interesting to insert a needle at times and empty out all the urine in the sac so far as possible, and then watch it refill. It would refill to the point where it was when I tapped it, and then within a few weeks would largely increase in size and we would have more fluid at the time of the third or fourth tapping than at the first. This showed that the kidney was still active in spite of the enormous dilatation that had been produced. I was able to influence the production of hydronephrosis in many of these by destroying the vessels that produced anastomoses over the cortex. This was done by tying off the vessels found to be concerned in this,—one or two veins in the lumbar region and the suprarenal vein and one or two others. It was appreciated that the capillary anastomoses between the kidney and surrounding fat were extensive and important, but could be destroyed by complete decapsulation. When this was done hydronephrosis occurred to a much less extent than in the others.

Dr. Hugh H. Young, Baltimore: The society is to be congratulated on having such a splendid paper, which is so complete that there is very little can be added to it.

Perhaps I may be permitted, however, to call attention to the work of Keith[3] who published an extensive report several years ago in which by the application of rubber bands around the ureter he was able to obtain a gradually developing hydronephrosis in animals, a condition quite often seen in prostatic hypertrophy. Functional studies in his cases showed the same gradual loss of function and a low phthalein output, as is seen in prostatic hypertrophy.

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[3] Keith and Pulford, Arch. of Internal Med., xx, 853, 1917.

Dr. Guy L. Hunner, Baltimore: I was extremely interested in this work. It is work of this sort that is of value beyond anything else.

One reason why I have been anxious to get members of the Society who have splendid clinics and opportunities to make careful studies on these various patients interested in the ureteral stricture work is that we see so many variations in the effect of back pressure in the individual cases, so many problems to be worked out that are difficult to explain. There is one group that I see more of than those with hydronephrosis, and those are the small pelves. These are the most painful ones and no matter what you use there is unusual pain, the kidney clamps down at once and sometimes you get an anuria of from ten to thirty minutes in this type and the X-ray shows a slightly smaller pelvis and a dilated ureter. I think some of these are nervous, reacting in a more or less tonic spasm trying to overcome the pain, and in that way they keep a small pelvis. The probability is that the pelvis is anatomically of normal size, but they react so quickly that the X-ray shows a smaller pelvis than a normal picture should.

I think another reason for these small pelves is an actual nephritis that has been set up. I am speaking of the noninfective cases, which I see more of than of these that show infection. I think many of these cases develop interstitial nephritis merely from the back pressure conditions. There is no real infection in the kidney, and still the outline of the kidney is smaller, the output of phthalein is smaller, and theygo to operation in a few cases. When the kidney is removed there is a great amount of atrophy, with no apparent infection.

SOME CASES OF SUPPURATIVE PERICYSTITIS

ARTHUR L. CHUTE
Boston

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In 1909, I reported a single case of suppurative pericystitis that had come under my care the year before. The condition was not clearly understood by me and my operation, I believe, was inadequate: the patient died thirty-six hours after operation (1). Since that time 5 cases of this interesting condition have come under my care; 3 of these have made a good recovery. A study of this group of cases allows us, I believe, to draw valuable conclusions regarding certain aspects of this condition especially as to its recognition and treatment.

The first of this series of 5 cases came under my care in June, 1911. This man, forty-nine years old, had had a stricture for years which had been operated upon ten days before I saw him. The operation had been a perineal section. The operator told me that after the perineal opening of the urethra there was great difficulty in introducing a catheter into the bladder. Immediately following operation there was a great diminution in the amount of urine excreted, getting down to 10 ounces in one period of twenty-four hours. After the kidneys had begun to excrete better the catheter came out and could not be replaced. For four or five days before I saw this man his temperature had been creeping up and for two days he had had a great deal of suprapubic pain. A mass had been felt above the pubes, which was supposed to be a distended bladder. This patient had a considerable temperature when I saw him and he was hiccoughing. There was a mass above the pubes as well as a slightly reddened area that extended as high as the anterior

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[1] Read at the meeting of the American Urological Association, Atlantic City, April, 1922.

superior iliac spine on the right. In places the skin seemed slightly edematous and there was a little crepitation on palpation. A catheter was passed into his bladder with difficulty and showed a residual of about 4 ounces of clear concentrated urine. The removal of this urine did not change the size of the suprapubic mass. This finding of a recently formed suprapubic tumor that is not affected by the emptying of the bladder, I consider pathognomonic of suppurative pericystitis and on this evidence I made that diagnosis and urged immediate operation.

The perineal wound was opened and a little pus was evacuated; a large tube was carried into the bladder and stitched in place. An incision was made on the right side of the abdomen below and internal to the anterior superior spine. It was carried through the muscle layers and allowed the escape of a lot of pus. This cavity extended over toward the pubes. A second incision made immediately above the pubes went into an abscess cavity which was connected with the abscess in the iliac region. Both these cavities were drained by tubes inserted from above. The patient improved and left the hospital where I had seen him in consultation. A month later he reentered a hospital under my care. There was still a considerable amount of purulent discharge from the tube in his right iliac region. It was further found that the posterior end of the anterior part of the urethra was occluded. The occluded end of the urethra was opened and connected with the posterior segment. The abdominal drainage tubes were left in place. During my vacation, which began a short time after this operation, this patient had two severe secondary hemorrhages and died as a result of the second. It was supposed that one drainage tube had ulcerated into one of his right iliac vessels; no autopsy was obtained, however.

The second case of this series was seen in consultation on July 5, 1915. The patient, a man of sixty, had had a suprapubic prostatectomy under ether two days before. He was getting out very little urine, was greatly distended, and was hiccoughing. His temperature was subnormal; his pulse was 120. The skin of the anterior abdominal wall was slightly red and edematous.

I removed the stitches, put in a large suprapubic tube, and drained a little infected area between the bladder and abdominal wall. The patient was put upon subcutaneous salt solution and stimulation. Ten days later he was reported as no longer distended; his bowels were acting well and he was getting out a good amount of urine. His temperature was a degree or two above normal but this was attributed to the infection of his suprapubic incision. Eighteen days after I first saw this man I saw him again; he had had a temperature that had been below 100 most of the time; his pulse had remained at just about 100; the suprapubic incision was everywhere grey and sloughing: there was a profuse discharge of pus of pronounced fecal odor. Exploration of the wound showed that the bladder was everywhere separated from the surrounding tissue, that on either side there was a pus pocket which extended down to the floor of the pelvis, while on the left the pus had dissected up above the crest of the ilium, nearly up to the region of the left kidney. All these cavities were drained by tubes brought out through the incision in the abdominal wall. I was told later that this patient failed and succumbed to his sepsis some two weeks later. There was no autopsy. I believe in this man, in spite of his condition, I should have established more direct drainage of this cavity, through the loin and ischio-rectal space as well as through the suprapubic incision.

The third case of this series concerned a man of fifty-one, whom I saw in a hospital in a neighboring city in May, 1917. During the previous eight years he had been catheterized three times because of acute retentions. When he had his fourth retention, which was on the day before I saw him, it had not been possible to pass any instrument to his bladder. I found that I could get a small bougie through into his bladder after taking some little time. As it seemed to me that the man had a false passage as well as a tight stricture, I advised operation. A perineal section was done under local anesthesia: the stricture in his deep urethra was cut, and a large catheter was carried into his bladder. This patient was not seen again until twenty-two days later when I learned that following operation he was quite well for a week. The catheter came out on the seventh or eighth day after operation. Persistent attempts were made to reintroduce it and to wash the bladder out with the result that the man had had fever since that time. I found his urine to be fairly clear and high colored. I found no difficulty in passing an instrument to his bladder and found but very little residual urine. After his bladder had been emptied, however, there was still a suprapubic mass having the contour of a full bladder. On the left of his abdomen, low down, there was crepitation on palpation. By rectum there was an arched condition that extended from one ischium to the other. His temperature was a little over 102 and his pulse was rather rapid. This man was etherized, and a median incision made which opened into a pus pocket that extended down on either side of the bladder. In front I could feel the urethra bridging across this cavity. The pus was most offensive. I made a slight incision in the perineum to the right of the median perineal incision and by blunt dissection carried a clamp up until it entered the pericystic abscess cavity. A large tube was pulled through from above giving dependent drainage. Tubes and wicks were carried down into this pericystic space from the suprapubic incision. A large catheter was placed in the urethra. This man was given salt solution in large amounts over a long period. He was very septic and improved but slowly. On the ninth day he developed a recto-urethral fistula which disappeared spontaneously after a week or two. This man finally left the hospital in October, in very good condition, nearly four months after his operation. I last heard from him some time during the following year, at which time he stated that he was in perfect health.

The fourth case of this series concerned a man sixty years old who presented himself in September, 1919, with the story that he had had trouble with his bladder for twenty years and that he had had a perineal abscess opened in London fifteen years before. His urine was almost milky and he passed but a few drops at a time attended with great pain. His prostate was negative; an exploring bougie was held up in the deep urethra. A very small bougie of the ram's horn type was finally passed to his bladder. On its removal the patient could void rather better. This investigation was followed by a chill and four days later I did a perineal section under spinal anesthesia. I opened the urethra at the point of stricture and cut it. I had the greatest difficulty in getting any instrument into the bladder but finally introduced a catheter that I supposed entered his bladder. I likewise put a tube into the perineal wound. The perineal wound was brought together loosely about this tube. The next day I was told that this man had passed no urine through his catheter or perineal tube but that there had been a considerable leakage through the perineal incision. My house officer had attempted to wash through the perineal tube. Each attempt had been attended with great pain in the lower abdomen and there had been no return of the fluid. When I saw this man the next morning he had an increased temperature and pulse rate. There was a very tender tumor above the pubes which led me to suspect a pericystitis and to advise immediate operation. I made a suprapubic incision and found the pericystic layer was infiltrated with bloody fluid. The bladder was opened but I could not feel the end of the catheter which I supposed I had inserted the day before. Neither could I feel it by rectum. It had evidently been inserted somewhere in the perivesical space. A staff was passed from the bladder and the urethra widely opened; the bladder was drained by means of a tube introduced through the perineum. A rubber wick was introduced into the place that the catheter had occupied. The perivesical space was drained from above by tubes and wicks. This patient had considerable reaction and had to have salt solution under the skin for a day or two. He left the hospital well, just about two months later. He was seen in February of this year in perfect condition.

The fifth case of this series concerned a man forty-three years old who was seen on July 28, 1921. His history was that he had been troubled with strictures for fifteen years. These had been operated on by various men. A week previous to my seeing him he had come under the care of the physician with whom I saw him. This doctor had dilated him up and had catheterized him.

He had discerned what he believed were false passages in his urethra. When seen by me this patient's abdomen was distended; he was vomiting; he had a temperature of something over 101, and a pulse of over 100. There was a fluctuating point in his perineum. There could be felt above the pubes a very sensitive mass which was perfectly compatible with an overdistended bladder. This man was given spinal anesthesia; the perineum was opened and a lot of pus escaped. The subcutaneous tissues of the perineum seemed to be great masses of slough. A catheter that was passed into his bladder let out a small amount of urine. This did not change the suprapubic mass from which I drew the inference that in addition to his perineal suppuration we had to deal with a pericystitis. A suprapubic incision was made. The pericystic space was filled with brownish, yellowish sloughs, which were extremely offensive. There was besides this some free pus. The bladder was opened and found to contain a little urine. The suppuration had dissected the bladder free on both sides down as far as the base. A clamp was pushed up from the perineal incision, on either side, until it entered the perivesical abscess cavity; tubes were pulled down by means of these clamps and brought out the perineal wound. This gave dependent drainage. I found below and behind a rather large cavity which seemed just anterior to the rectum. This was drained by a wick. The suprapubic incision was closed loosely about tubes and wicks. There was more or less gas in the tissues but no connection with the rectum could be made out either at the time of operation or later. Salt solution was given under the skin over a period of two weeks. Tubes and wicks were slowly shortened. The patient went home early in October, having been in the hospital something over two months. He has presented himself for observation within a week. He has been at work now for some months and is in perfect condition except for a small perineal fistula which leaks a little when he voids.

In this condition, which has gone under various names, suppurative pericystitis, suppuration of the perivesical space, and phlegmon of the space of Retzius, the whole of the pericystic layer may be converted into one huge abscess cavity. This cavity may extend off to the sides of the pelvis as in cases 1 and 3 and may on occasions even extend up into the loin, as in case 2. The process is necessarily retroperitoneal.

In the reported cases the etiology was quite clear: in four of these cases the infection followed traumatism of the deep urethra while in the remaining case the infection followed a suprapubic cystostomy in which the perivesical space had been infected and not adequately drained. It is possible, I suppose, that in some of the cases, especially those infected from below, the infection may have been carried to the space of Retzius from the wounded deep urethra by the lymphatics, but the fourth case, the one where the house officer syringed through the perineal tube, causing great abdominal pain at the time, suggests that in this instance at least the tube must have been introduced into the perivesical tissue itself. The finding of bloody fluid in the space of Retzius at operation the next morning, as well as the acute abdominal pain at the time of this attempted investigation would, I believe, point to the direct introduction of the infection rather than to infection through the lymphatics. In most instances I believe the infection is introduced directly into this perivesical space, perhaps behind the prostate in most instances, but it seems probable that in some cases the prostate itself may be perforated and the pericystic layer opened up in this way. This suppuration of the perivesical space does not seem to have followed suppuration of the prostate itself with any degree of frequency. It would seem as though the capsule of the prostate offered a sufficient barrier to protect the perivesical space in such cases. In the first case that I saw, not reported in this paper, in which a pericystic abscess pointed in the rectum, it was above the region of the prostate. In this same case there was no trauma of the urethra and no suprapubic incision to act as an etiological factor; the man, however, did have a considerable degree of chronic cystitis. The infection in this instance may have been through the bladder or possibly it may have been through the blood stream. No cultures were made from any of these cases; the odor of the pus in some of the instances would suggest the presence of the colon bacillus.

In such cases as I have seen, the recognition of this condition should have been very easy and it was very easy in the later cases. There is one sign that I believe we may consider pathognomonic and that is, the presence of a recently appeared suprapubic tumor that is tender and that is unaffected by emptying the bladder. This sign has been present in the 6 cases I have seen. This, with the story of urethral trauma followed by suprapubic pain and the general evidence of infection, should leave no doubt as regards the diagnosis. Women are said to have this condition occasionally, though far less often than men. I have never seen a case in a woman.

My personal experience, the loss of 3 out of 6 patients, would seem to indicate that this condition is a serious one. I believe it is only fair to say, however, that in none of the cases that I lost was real effective drainage established. In the first patient, the case reported in my previous paper, I did not even open the pericystic space suprapubically, just opened a collection of pus above and behind the prostate. The second case I believe might not have had his secondary hemorrhages had my drainage tubes been brought out through the perineum, giving really efficient drainage, which would presumably have required the presence of the tubes for time less than was the case in the uphill drainage that I used. In the third case, the second reported in this paper, the patient was not adequately drained in the light of what I now know. Of the 3 that recovered, the 2 in whom the space of Retzius was one vast abscess cavity, were drained by tubes that were carried down from the abscess cavity at the sides of the bladder through the ischio-rectal space and brought out in the perineum. This afforded most efficient drainage. In the third instance in which the process had apparently begun the day before, the cavity was drained simply from above. In most of the cases a suprapubic tube was put in the bladder. I believe that it must be of advantage to place the bladder at rest under those conditions. One might expect that following so extensive a process the bladder would show, after recovery, a considerable diminution in its distensibility. This is not evident in the two cases that I have had a chance to examine some time after operation, the fourth and fifth cases reported in this paper: in both of these the bladder showed a good capacity.

I may sum up briefly: cases of suppurative pericystitis are occasionally seen following trauma to the deep urethra—the condition is made evident by the presence of a tender mass above the pubes that does not disappear on emptying the bladder; this is combined with the usual evidence of an infection. The condition should be met by opening up the perivesical space and draining the cavity by tubes brought out through the perineum as well as by tubes introduced above. It will usually be wise to combine a suprapubic cystostomy with this drainage. In the cases that present a tight stricture, a badly traumatized urethra, or suppuration of the perineum, a perineal section should be done. The patients are usually very septic and the vigorous and prolonged use of subcutaneous salt solution is of great help in combatting this condition.

REFERENCE

(1) Chute, Arthur L.: Suppurative pericystitis, Boston Med. and Surg. Jour., September 23, 1909, clxi, 438.

DIVERTICULA OF THE BLADDER IN CHILDREN[1]

ABRAHAM HYMAN

From the Surgical Service of Dr. Beer, Mount Sinai Hospital, New York City

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Until comparatively recent years, diverticulum of the bladder in adults was considered very rare; only half a dozen cases having been reported in American literature, up to the year 1906. Since then, however, many articles have appeared with numerous case reports, so that, at the present time, the condition cannot be considered very unusual. The increase in cases during the past decade is, no doubt, due to the almost routine application of the cystoscope and X-ray in the study of the diseases of the urinary organs. At the present day, we are in the same position concerning our knowledge of diverticulum of the bladder in children, as we were for adults in 1906. After carefully searching the American literature only 3 case reports in patients under ten years of age were found. This is rather surprising, because at present most writers favor the congenital theory of the origin of these pouches. In fact, some authors point to the extreme rarity of this condition in childhood, in support of the acquired theory of formation. Undoubtedly vesical diverticula are more frequently present in children, than would be inferred, many being overlooked because the proper methods of examination have not been carried out. It is only in recent years, that cystoscopy in children has been used, and we can, no doubt, look forward to an increase in the number of case reports, as soon as this procedure is more popular.

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[1] Read at the meeting of the American Urological Association, Atlantic City, April, 1922.

INCIDENCE

It is, by no means possible to state in exact figures, the incidence of vesical diverticulum in the young, for the cases reported by one author are quoted by others, without mentioning explicitly the source of information. As a result, some of the series overlap, making the number of cases appear greater than they really are. That the condition is very infrequent may be attested by the following. None of the standard text books of pediatrics, even mention this anomaly. Hinman (1) collected a series of 209 cases of diverticula, from 1899 to 1919, in which but 1 occurred in a patient under ten years of age. Fischer (2) collected 48 cases from the American and German literature, up to 1910, in which 6 were in children below fourteen years of age (clinical and autopsy findings). Two children (eight and twelve) years) were cured by operation. The youngest was in a child of twenty months. These cases were probably the ones described by Englisch (3). Single cases are reported by Wallfield (4), McNeil (5) and Young (6), the latter's being included in Hinman's series. A search of the German literature makes no reference at all to this condition in children since the very comprehensive paper compiled by Englisch (7) in 1904. In this article, the author collected 171 vesical diverticula in which calculi were found associated (operative and autopsy statistics). Twenty-two occurred in children below ten years of age; the youngest being an infant eight days old. These cases are cited by Englisch, in support of the congenital theory of the formation of diverticula. Durrieux (8), in an excellent monograph which appeared in 1901, reports in detail, 195 diverticula of the bladder, 13 of which occurred in children below the age of ten years. In 8 of the 13, calculi were found associated. A diverticulum was found in the fetus in 2 instances. In no case was the diagnosis made by cystoscopy or cystography. The majority were discovered on the operating table or at post-mortem. Some of the cases described by Durrieux, were also cited by Englisch. Analyzing most of the published articles, which have appeared during the past two decades, approximately 600 cases of diverticula of the bladder have been reported; between 25 and 30 of these occurred in children below the age of ten years.

ETIOLOGY

Diverticula have been classified as true and false, the former comprising those in which all the coats of the bladder are present in the sac; whereas the false are formed by mucous membrane alone. Two types of true diverticula, the congenital and acquired, have been described, and at the present day, despite much careful investigation, a considerable difference of opinion still prevails, concerning the underlying etiological factor. No attempt will be made here to discuss this point in detail, for it has been ably presented in late years, by other writers. Suffice it to say, that there are supporters of each theory. Cabot (9); Rathbun (10), Israel (11) and Hofmokl (12) are of the opinion that the great majority of diverticula are congenital in origin, others, Howard (13), Lerche (14), Wagner (15), Hinman (16) and Thomas (17) consider them all acquired. Then there is group of observers, (Englisch (18), Judd (19), Fisher (20) etc.) who are of the opinion that both factors (congenital and acquired) are responsible for their development. Until recently, Lower (21), who has had considerable experience in the treatment of this condition, stated that these pouches are practically always acquired. However, as a result of Watson's (22) recent publication, Lower now inclines more to the belief that "there is a congenital predisposition to diverticula." The fact that these pouches had been found in the fetus, was used as an argument in favor of their congenital origin. Watson, in a study of the development of the lower genito-urinary tract, found it possible to observe the vesical cavity in its progressive development, from early fetal life until birth. "In the course of these studies, certain pictures of the bladder cavity have been of striking significance, and it appears, that certain factors are present, which may be of importance in determining the formation of diverticula." Watson believes that, whereas there is a congenital predisposition to diverticula, "their clinical recognition during adult life is hastened, and their dimensions greatly increased by any of the factors that would bring about increased vesical distention or increased activity of the bladder musculature." One further favors such an opinion after carefully studying many of the case reports in adults, when it will be found, that the duration of urinary symptoms often date back ten to fifteen years, and in some instances, even to early childhood.

The following report is based upon 3 cases of diverticula of the bladder, observed during the past six years; 2 occurring in young children, and 1 in an infant of nine months. Before describing them in detail, it will be well to discuss, in a general way, certain features, and show wherein this condition in the child differs from that in the adult. Attention has been called to the fact, that in congenital diverticula, other anomalies in the genito-urinary tract, such as double renal pelvis, double ureter, spina bifida, etc., are frequently present. In 1 of the 3 cases there was a hypospasias, the others showed no anomalies.

Number of diverticula. Two symmetrically placed pouches were found in the infant; the other 2 patients had single sacs. The size of the pouches varied from that of a small plum, to that of an orange.

Location. As in the adult, the site of prediliction was in the neighborhood of the ureteral orifices. The position of the sac is of more importance than the size, for small diverticula in close proximity to the ureter, by compromising its lumen, do far more damage than large ones which are so situated as not to involve the ureters. In these 3 cases, the diverticulum was found so closely adherent to the ureter as to occlude its lumen, requiring division and reimplantation into the bladder.

Sex. All 3 cases occurred in males; there is no reported case of a diverticulum in a female child. In the adult, but 10 in 205 cases were in females.

Age. One patient was nine and one-half years old at time of operation; the second, three years, and the third, eight months.

Urine. A marked pyuria was present in all three instances. It is a curious fact, that we rarely see these cases early in their course when the urine is clear. It is not until urinary infection supervenes, bringing on an added train of symptoms, generally acute in character, that medical advice is sought.

Position of ureteral orifice in relation to sac. In 2 of the cases, the diverticulum lay anterior to the ureter. In the third, the right ureter opened into the diverticulum, the orifice of which had a contractile sphincteric action. A real sphincteric action of the diverticular opening is very rare, and has been described but a few times, (Buerger (23), Pagenstecher (24), Blum (25)., Twelve cases have been reported in the literature, in which the ureter opened into the sac.

Residual urine. It is of interest to note all of the cases showed a residual urine, varying in amount. The infant had complete retention; catheterization twice daily yielded 12 to 14 ounces of urine each time. In this instance, the retention can be explained by the pressure of the two large sacs causing obstruction at the bladder neck. After excision of the pouches spontaneous urination occurred. The other two patients had smaller amounts of residual urine. In case 3, there was never more than one ounce of residual urine, yet the bladder could be palpated, reaching as high as the umbilicus. At operation, this was found to be due to a marked hypertrophy of the vesical musculature.

DIAGNOSIS

The diagnosis of this condition in children should not entail more difficulties than in the adult. True, we are denied the information which can be obtained by a recital of subjective symptoms, but this is not so important, for at best, the evidence so obtained is uncertain. The symptomatology of diverticulum, even in the adult, is by no means sufficiently clear to class it as a clinical entity, and the same applies for this condition in childhood. It is of interest to note, that in contradistinction to the history usually obtained in adults, the duration of symptoms was very brief, and the onset sudden, in all three instances. In 2 cases, the initial symptom was an acute retention, in the other, a hematuria which first occurred six days prior to admission. Pyuria was present in a marked degree in all. Undoubtedly, these diverticula were present since birth, but it was not until urinary infection supervened, that the condition became acute. Two of our 3 patients had been treated for pyelitis, pus having been found in the urine. It might be well, at this point to digress for a moment on the subject of pyuria in childhood. The presence of pus in the urine, seems to be a sufficient excuse for the diagnosis of pyelitis. We have examined a number of children within the past few years, treated for long periods of time for pyelitis, in whom serious diseases of the lower urinary tract was present, the kidney infection being a secondary involvement. One should be extremely careful, especially in male, children, before attributing a pyuria to a pyelitis. In none of the cases had a cystoscopic, or X-ray examination been made, prior to admission to the hospital. This is not surprising, for these diagnostic procedures have not as yet been accorded their due recognition in the study of uroiogic diseases in the young. Having determined the presence of pus in the urine, the next step should be to make a careful abdominal examination, inspecting and palpating carefully, the suprapubic region. The importance of this cannot be over emphasized. In our 3 patients, there were always varying amounts of residual urine, with consequent distention of the bladder. A protuberance in the suprapubic region was distinctly visible, and the bladder could be palpated, reaching to the umbilicus. Such a distended bladder, should immediately focus our attention on the two conditions which cause residual urine in childhood. These are the chronic retentions of urine due either to a mechanical obstruction, or to a neurological condition; or, a diverticulum of the bladder. Should the distention be asymetrical, it would lead one to suspect the presence of a diverticulum. Catheterization should follow, note being made of any obstruction in the urethra, and of the amount of residual urine. A definite diagnosis, however, cannot be made, without resorting to the use of the cystoscope or cystogram, or both combined. Of the two, the cystogram is of more importance in children, and will give more useful information, than cystoscopy. Cystoscopy is at times, difficult in the young, especially in the presence of a marked pyuria, when it may be impossible to cleanse the bladder sufficiently to obtain a clear picture. Although cystoscopy shows us the orifice of the pouch, it gives no idea of its size and shape. It may even be possible during the course of a careful examination to overlook a diverticulum with a small opening. Cystography is such a simple procedure, that it can be performed even in very young children, without the slightest difficulty and requires no anesthethic. In our youngest patient, cystoscopy could not be carried out, because it was impossible to obtain a sufficiently clear medium to see through, the purulent urine from the sac, constantly clouding the field of vision. The roentgenograms should be taken in different positions, otherwise a small sac may be overlooked or the shadow of the diverticulum may be obscured by that of the bladder itself. In young children, it is possible to obtain excellent pictures in the lateral, as well as anterior posterior positions. Contrast cystography, as recommended by Hinman (16), may give added information. This is accomplished by first taking a plain cystogram; then the solution is drained off and air injected, and another plate taken. The air filled bladder stands out in contrast to the sacs containing the opaque solution, which has not as yet drained away. Should cystoscopy and ureteral catheterization be feasible, it may be found of value to introduce a leaded catheter into the ureter, so as to outline its relation to the sac. The passage of an opaque catheter into the sac does not give as valuable information as the cystogram.

PROGNOSIS

In general, it may be stated, that the prognosis is favorable, provided there has not been irreparable damage of kidney tissue. It is surprising to note, how well children stand the major operative procedures necessary to effect a cure. Before undertaking operation, it is of extreme importance that kidney function should be carefully studied, and attempts made by hygienic and dietary measures, to put these little patients in the best of condition. Attention may here be called to the fact, that in cases 2 and 3, successful results were obtained, although the function was very low. It may be necessary, when there is a large residual urine, to drain the bladder with an indwelling catheter, and combat infection by bladder irrigations. By carefully prepared preoperative treatment, the mortality should be very low.

TREATMENT

Conservative, non-operative measures are of no avail. Constant daily vesical irrigations are useless, as are any other non-surgical methods. Rathbun (27) has suggested a preliminary suprapubic drainage, which may occasionally be of value in tiding over a very sick child, until the local and renal condition have improved to a degree, warranting more radical procedures. The best results are obtained by radical extirpation of the sac, by an extraperitoneal exposure of the bladder. Good results have also been obtained in the adult by the intravesical excision, advocated by Young (28); however, the former operation should be the one of choice. The technique of operation is similar to that employed in the adult, and has been fully described in various publications. A few words as to the proper treatment of the ureter. In a large number of cases, the diverticulum will be found in close proximity to the ureter. The difficulty in identifying the ureter, and separating it from the sac when dense adhesions are present, is eliminated by exposing the ureter above the diverticulum, making a small slit in it, and passing a bougie down through it, into the bladder. This method also gives us immediate information as to its patency. When the ureter is occluded, there is but one course to pursue, namely, its division and reimplantation, into another part of the bladder. When the ureter opens into the diverticulum, or adjoins it, two methods of treatment are applicable. Young (29) a number of years ago, suggested a technique which leaves a flap of bladder wall around the ureteral meatus, after completely excising the rest of the sac. The flap containing the orifice, is then sutured into the bladder wall. Judd (30), recommends, that in those cases "in which the ureteral opening is found marginal, the adjoining mucous membrane should be turned into the bladder closure," the meatus being preserved. It is advisable whenever possible, to employ a technique which does not interfere with the integrity of the ureteral mechanism. In our 3 cases, the ureter on the side of the sac was found occluded, requiring division and reimplantation into the bladder. Some years ago, Cabot (31) suggested ureteral drainage for the dilated urethers, in which division, or the Young flap operation had been done. He introduced a soft rubber catheter into the ureter, reaching up almost to the renal pelvis, bringing its lower end out through the suprapubic wound. In the cases in which this technique was employed, the post operative course was unusually smooth.

The following three cases on which this paper is based, are of such unusual interest, as to warrant their description in detail.

Case 1. M. B., male, age nine and one-half years, admitted to Mt. Sinai Hospital, March 15, 1915.

History. Except for diphtheria, past history was negative. Six days before admission, noticed terminal hematuria, accompanied by pain on urination. After micturition felt that he had not finished, and could always void a little more. There has been pain in the hypogastric region.

Examination. Showed a penile hypospadias. The voided urine was turbid, contained much pus and a heavy trace of albumen. There was slight lumbar tenderness. Bladder distended; neurological findings, negative. Phthalein test, 45 per cent, no tubercle bacilli found in urine.

Cystoscopy—shows the opening of a diverticulum in the left bladder wall, near site of left ureteral orifice. The orifice appears to open near the mesial posterior edge of the diverticulum. Indigo carmine is seen pouring out in good concentration. The right ureteral orifice is patulous. Good indigo concentration in fourteen minutes. A cystogram with argyrol, revealed distinctly, a large diverticulum, also a dilated left ureter (figs. 1 and 2).

Operation. March 27, 1915 (Dr. Beer). Extraperitoneal extirpation of diverticulum of bladder and lower end of left ureter, with implantation of ureter in posterior wall; suprapubic drainage. Through a median suprapubic incision, the bladder was separated from the perivesical tissues, and the very thin peritoneum, pushed off with difficulty. In so doing, the peritoneum was opened, permitting of digital exploration of the peritoneal cavity. After repairing tear in peritoneum, the bladder was filled with fluid, and the diverticulum was located in between the trigone and rectum, firmly wedged in the pelvis. By drawing the bladder out of the abdomen after it was freed, it was possible to deliver the diverticulum from its bed, and ligate its neck. The diverticulum lay in such a position, between the course of the two ureters, that whenever it was full, it of necessity compressed these. The left ureter was markedly distended, and was cut across, about an inch from the bladder, where it became intimately adherent to the inflamed wall of the diverticulum. The ligated neck of the sac, and the lower end of the ureter, were buried in the bladder wall with several

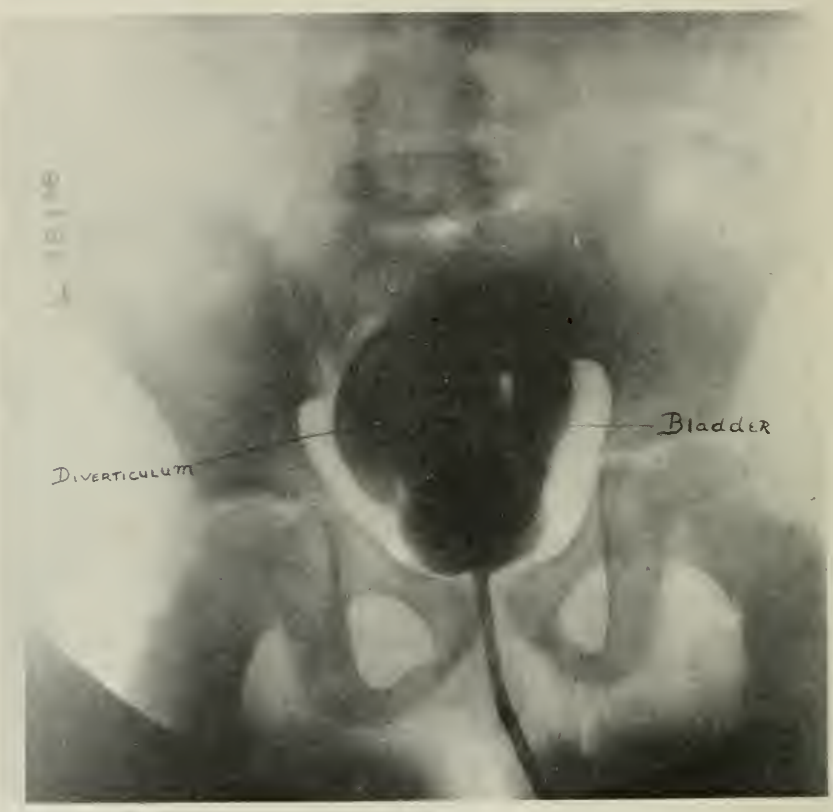

Fig. 1

layers of sutures. Then the ureter was implanted in the left posterior wall of the bladder. Two weeks after, drainage tube removed. Kader functionates well, patient remaining dry. Uneventful convalescence. Cystoscopy six weeks after operation shows that neostomy functionates well. Patient last examined March, 1922, seven years after operation. He is perfectly well and has no urinary symptoms. The urine is clear, and shows no abnormal elements. Patient refuses cystoscopic examination, so that it cannot be determined whether or not the neostomy is functionating.

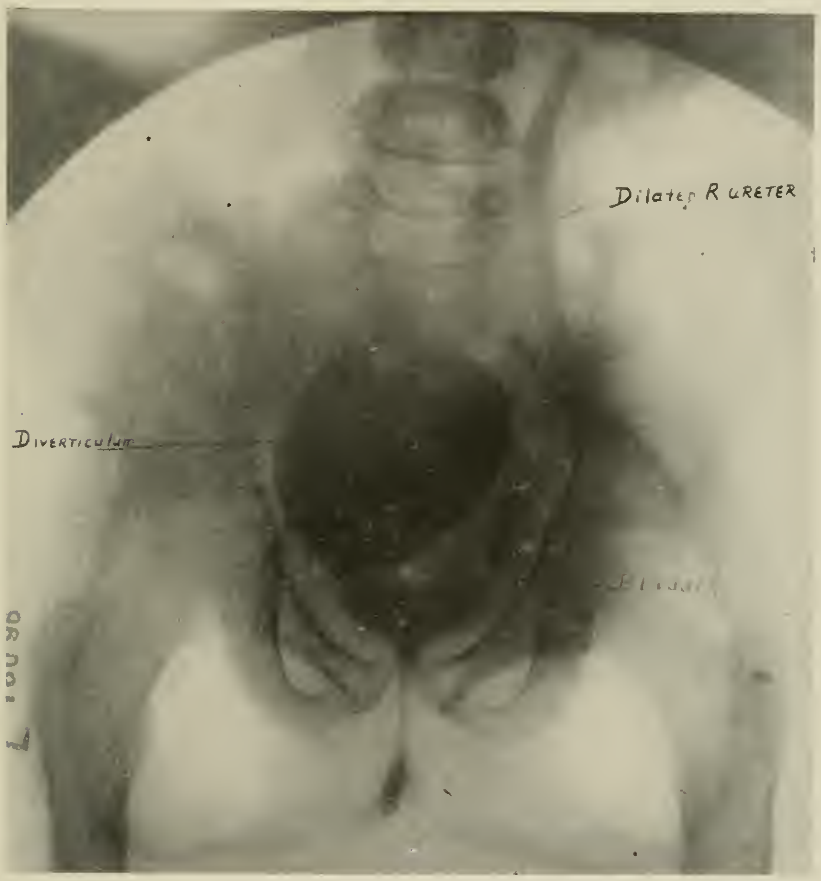

FIG. 2

Summary. A boy of nine and one-half years, with a urinary history of one week's duration; and pus in the urine. Cystoscopy and cystogram revealed a diverticulum of the bladder, with a dilated left ureter. Operation disclosed a diverticulum, behind the trigone, pressing on both ureters and attached to the left ureter, which had to be sacrificed in its lower 1 inch on resecting the sac. Normal convalescence. Patient well seven years later. No evidences of any obstruction in the lower urinary tract were found.

Case 2. The patient, H. F. a male infant, 9 months of age, was admitted to Lebanon Hospital, Service of Dr. Haas, February 7, 1921. I am indebted to Dr. Haas, who asked me to see this most unusual case, a few days after admission.

History. The infant was a full term baby, normal delivery and normally developed. He was well until January 9, 1921 (four weeks before admission), when symptoms developed which were attributed to indigestion. There were frequent loose green stools, abdominal cramps and fever. Castor oil was administered, but the illness continued unchanged for the next few days, when the mother noticed that the baby's abdomen was becoming progressively more distended. At about this time, it was also noticed that very little urine was voided, and then urination stopped for one day. No specific significance was attached to this. Previous to this, no urinary symptoms had been noticed. The temperature rose to 104°, and a diagnosis of intussusception was made, and immediate operation was advised. A surgeon called in consultation, concurred with this diagnosis, which was made on the history of diarrhea, abdominal distention, and a large mass which could be palpated, abdominally and per rectum. At operation, as well as we could determine, no intussusception was found, but instead, an enormously distended bladder, reaching above the umbilicus was discovered. The abdomen was immediately closed, a catheter introduced, and 32 ounces of purulent urine withdrawn. For three days following operation, there was complete retention, requiring daily catheterization. Then spontaneous voiding, in small amounts ensued, mainly dribbling in character. Catheterization had to be carried out daily, on account of the large residual (12 to 18 ounces). For the past three weeks the temperature fluctuated from normal to 104°. The infant became progressively worse, lost considerable weight, became very anemic, took little nourishment, and had a number of convulsions. The baby was admitted to the hospital February 7, 1921, in a most desperate condition. The admission notes read as follows.

Examination. The infant is comatose, makes continuous sucking movements with its tongue, which is thick and dry and coated. There are convulsions of the upper and lower extremities from time to time. The abdomen is distended, and the bladder can be palpated, reaching to the umbilicus. The temperature ranges between 102° and 103°. It can therefore be seen from this description, that the baby was in a most desperate plight. Daily catheterization revealed a residual, varying between 10 and 18 ounces of turbid urine, acid in reaction, 1023, loaded with pus, and containing a heavy trace of albumen. Cultures of urine showed colon bacilli and Staphylococcus aureus. The phthalein test was less than 10 per cent for two hours. Blood urea 45 mgm. per 100 cc., non-protein nitrogen 98.4. Indigo carmine did not appear in the urine until ten hours after injection. X-ray of urinary tract, negative. In order to improve the baby's condition, it was considered advisable to resort to catheterization twice daily, followed by bladder irrigations; water was forced, being given by mouth, rectum and hypodermoclysis. Under these measures, there was some improvement noted in the general condition; the functional tests showed no change. Cystoscopy could not be performed, on account of the impossibility of obtaining a sufficiently clear medium, despite prolonged irrigations. A cystogram was then taken, injecting 12 ounces of 20 per cent sodium bromide. The radiograms taken in the lateral and anteroposterior position, show distinctly two large diverticula, one on each side of the bladder (figs. 3 and 4).

A definite diagnosis having been established, the question of operation arose, but it was considered advisable to wait until the general condition and renal function showed more improvement. This was accomplished by April 19, more than two months after admission to the hospital.

Operation. April 19, 1921 (Dr. Hyman). Ether anesthesia. Through a median suprapubic incision, the bladder was exposed, found markedly enlarged, thinned out and flaccid, reaching as high as the umbilicus. After separating the bladder from the peritoneum, the viscus was opened, and two large diverticuli were found, one on each side of the bladder. The orifices of the diverticula admitted the index finger, and each sac was found intimately adherent to the bladder, and surrounding tissues. By introducing a finger in the sac, it was found that its mobilization could be more readily carried out. The sacs, both the size of oranges, were in this manner, freed extriperitoneally, down to their entrance into the bladder. The right ureter was seen, normal in size, running along the posterior wall of the diverticulum, from which it was readily separated. The right sac was then excised, and the opening in the bladder wall, closed with two layers of sutures. The left ureter, considerably dilated, was found firmly adherent to the posterior wall of the sac from which it could not be separated. About an inch above the meatus, the ureter was found to be strictured, so that the smallest probe could not be introduced, either upwards, through the

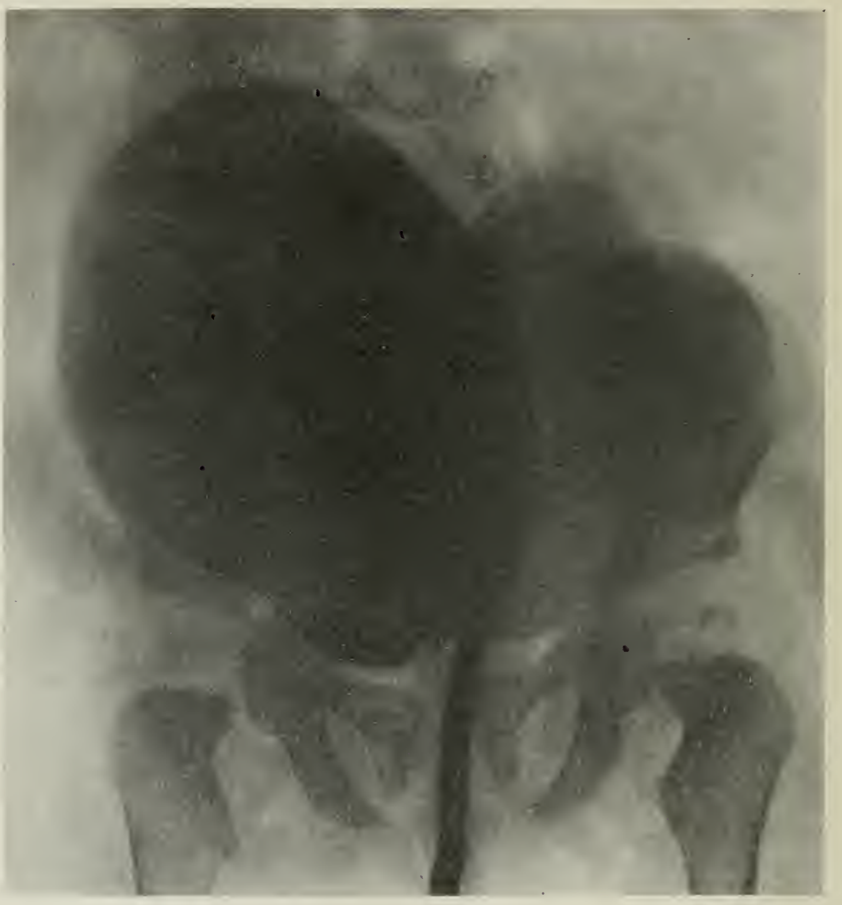

Fig. 3

Figs. 3 and 4 showing lateral view of diverticulum.

orifice, or downwards, through a small incision made in the ureteral wall. At this time it was realized that the kidney on this side was most likely very seriously damaged, but it was considered advisable to adopt conservative methods. The sac, with about an inch of ureter, was excised, and the bladder opening, closed with two layers of sutures. The ureter was then reimplanted into the left posterior wall, allowing a half inch or so, to protrude into the bladder. The internal urethral orifice was explored with the index finger, no contraction or evidences of obstruction were found. The ring was smooth and soft, and the tip of the little finger could be easily introduced through it. (There was at no time any obstruction to the passage of catheters, or bougies through the urethra.) The bladder was closed in layer sutures, allowing space for tube drainage. The abdominal wall sutured, drains in prevesical space. Time of operation, fifty-five minutes.

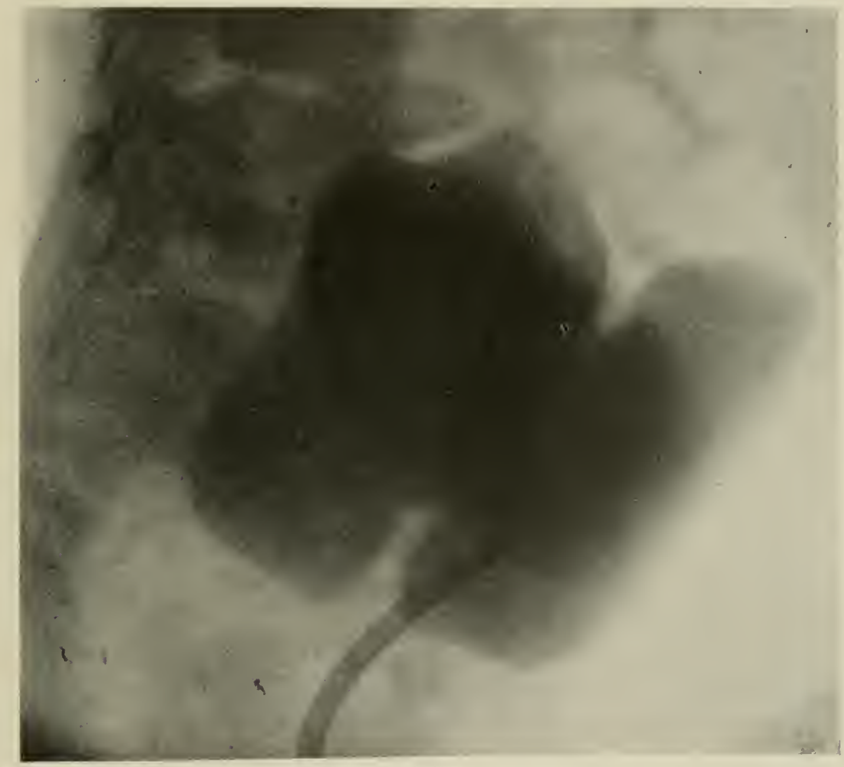

Fig. 4

Pathological report. Sacs have a smooth glistening appearance, and are thin walled. Microscopically, specimen is covered with a narrow zone of epithelial tissue, which ranges from flat to cuboidal cells, within this lining is loose connective tissue with numerous blood vessels, and sparsely infiltrated with small round cells. Surrounding this layer is a dense muscular layer.

Result. Following operation, the baby was considerably shocked for the first twenty-four hours, from then on, improvement was steady. Drainage through the suprapubic tube was profuse, and the urine became considerably clearer. From week to week, the general condition improved; the infant gained weight, temperature dropped to normal. Within a month, the phthalein test was 45 per cent for two hours. The suprapubic wound closed, except for a tiny opening at its lower end, through which purulent urine constantly escaped. Despite all treatment, it was found impossible to close this sinus. On examination one day, it was found, that by pressure over the left kidney, the flow through this opening was considerably increased; and it was then realized that the profuse purulent drainage was probably due to a pyonephrosis with a pyoureter. Under these circumstances, there was little likelihood of closing the sinus, unless the kidney was extirpated. This state of affairs persisted for almost seven months, during which time the baby improved remarkably. The local condition remaining the same, the parents finally consented to another operation which was performed, November 29, 1921 (Dr. Hyman). A suprapubic incision was first made, and the sinus was traced from its lower end. It was found to communicate with the enormously dilated left ureter. This was the ureter which had been reimplanted, and had evidently become partially detached, at the site of the neostomy. The sinus was therefore extravesical. The baby was then turned on his side, and a left lumbar incision made, and after considerable difficulty a complete nephroureterectomy was performed, removing the kidney and ureter, down to its vesical end in one piece. The kidney was completely destroyed, being merely a pus sac, and the ureter was so dilated as to be at first mistaken for large gut. The lumbar wound was closed in layers, and a tube introduced into the bladder for drainage. The child quickly recovered from the shock following this procedure, which lasted almost an hour. Despite an otitis media, which later developed, the baby was discharged from the hospital six weeks after this operation, with both wounds closed, and voiding a clear, normal urine. On last examination, a few weeks ago, the baby was found to be in excellent condition; he has gained considerable weight, seems to have no difficulty in voiding, and looks the picture of health.

Summary. An infant eight months of age. Seized rather suddenly with acute abdominal symptoms. Operation for intususseption, revealed instead a distended bladder. Then it was realized for the first time, that the trouble was due to a vesical condition. Cystography revealed bilateral diverticula, which was excised, and the left ureter which was compromised, was divided and reimplanted. Subsequent failure of the suprapubic wound to heal, due to a pyoureter on the left side. Nephroureterectomy, complete recovery. No evidences were found of any obstruction to urination. This is probably the youngest case on record, in which a diverticulum was successfully removed.

Case 3. S. L., male, age three years. Admitted to Mt. Sinai Hospital (service of Dr. Beer) February 11, 1922.

History. Normal delivery, whooping cough, otherwise well, until six months ago, when child had retention of urine, relieved spontaneously. Since then, urine has been cloudy, and has had attacks of painful urination. Has pain in back and both loins occasionally. Sweats profusely, no chills.

Examination. Showed an anemic, undernourished child. The abdomen, below the umbilicus is protuberant, and the bladder can be distinctly palpated. Lower pole right kidney is palpated. The urine is turbid, contains a trace of albumen, and is full of pus. Catheterization: no obstruction encountered, only 1 ounce residual. The enlarged bladder was due more to a markedly hypertrophied bladder wall than an actual dilatation. X-ray of urinary tract, negative. Phthalein test 10 per cent for two hours. Blood chemistry shows increase of non-protein nitrogen (49.9). Cystoscopy (ether anesthesia), bladder slightly inflamed. Left meatus normal. Right meatus cannot be seen. In this region there is an opening of a diverticulum, the orifice of which has a distinct sphincteric contractile action. When closed, it is difficult to make out its location; when open, it discharges a turbid fluid. At the time, it was surmised that the right ureter opened into this diverticulum. No indigo carmine from either side in fifteen minutes observation (appeared in voided specimens sometime later; late indigo carmine excretion). Culture of urine showed. Staphylococcus aureus. Cystogram shows a small diverticulum on the right side of bladder (fig. 5).

The condition of the child while in the hospital became progressively worse. High temperature developed which was attributed to a right pyelonephritis.

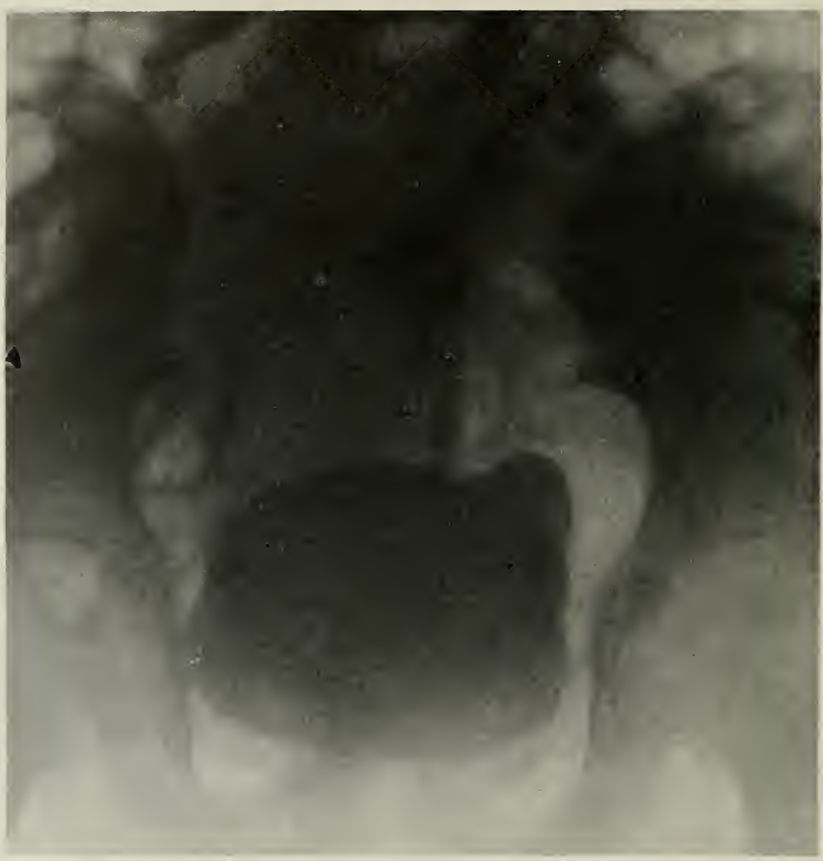

Fig. 5.

A cystogram showing a small diverticulum of the bladder.

Operation. Was decided upon, and was performed, February 25, 1922 (Dr. Beer). Suprapubic incision. Deep down in the pelvis on the right side, and firmly adherent to surrounding parts and ureter, is a small diverticulum. Marked peri-diverticulitis. The ureter which was considerably dilated, and found to open into the diverticulum, was divided at its constricted portion, just as it entered the sac. The sac was then dissected, free to the bladder wall, and excised. Opening closed with chronic sutures. Ureter implanted into posterior wall of bladder. The left ureter was seen in the bottom of the pelvis markedly dilated, probably due to the obstruction caused by the extensive peri-diverticulitis. Bladder drained through a stab wound, rubber drain in prevesical space. Child considerably shocked after operation, transfusion required, temperature reached normal in a few days, and then steady convalescence. The urine which was markedly purulent after operation, is gradually becoming clearer. The bladder wound is closed, child voids freely, right kidney is not palpable or tender. A cystoscopy will be done in the near future, to determine whether the neostomy is functionating.

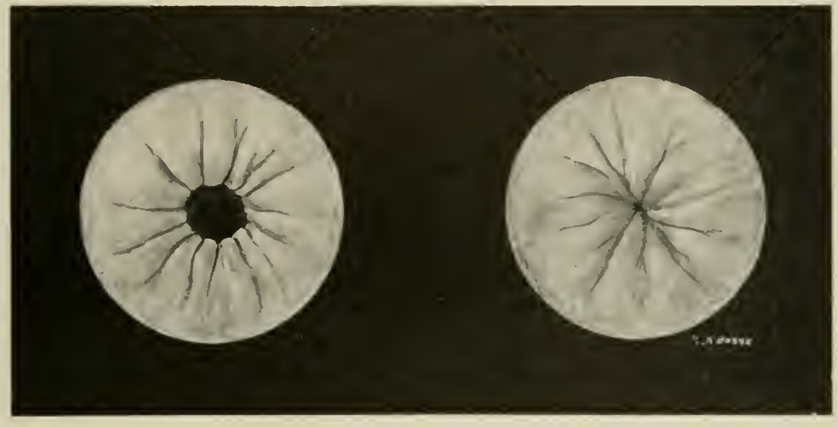

FIG. 6.

Showing cystoscopic appearance of diverticulum open and closed, demonstrating sphincteric action of orifice.

Summary. A boy of three years with a history of retention and pyuria of six months duration, found by cystoscopy and cystogram to have a diverticulum, which opened into the right ureter. Operation, excision of sac, division of ureter and reimplantation, recovery.

CONCLUSIONS

Vesical diverticula are rare findings in childhood, not more than 30 cases being found in a review of over 600 cases.

Diagnosis of this condition in children should present no difficulties. Little value can be placed on the value of the history. Physical examination of the abdomen is of considerable importance. A chronically distended bladder especially asymmetrical in outline, should make one suspicious of a diverticulum. The cystoscope and cystogram are absolutely essential in making a correct diagnosis. Of the two, the cystogram will be found more valuable. No evidences of obstruction, either vesical or urethral were found in these three cases. All 3 diverticula were in immediate proximity to the ureter, in 1, the ureter opened into the sac, and as a result, the ureters were compromised to such a degree, as to cause obliteration of the lumen, with resultant dilatation. Division of ureter with reimplantation performed in all 3 cases.

Undoubtedly we can look forward to an increase in the number of case reports, as soon as cystoscopy in children becomes more of a routine procedure. The presence of diverticula in patients so young, without evidences of any obstruction, leads one to conclude that they were congenital; and that in all probability, many of the diverticula in adults have also a similar origin.

REFERENCES

(1) Hinman, F.: Etiology of vesical diverticula. Jour. Urologie, 1919, iii.

(2) Fischer, H.: Congenital diverticula of the bladder. Surg. Gyn. and Obst., 1910, x.

(3) Englisch, J.: Eingesackte Steine der Harnblase. Wiener Med. Woch., Nr. 25, 1903.

(4) Wallfield, J. M.: Congenital diverticulum of the urinary bladder in infants and children. N. Y. Med. Jour., May 22, 1915.

(5) McNeil, W. H.: Internat. Jour. of Surg., 1918, 368.

(6) Young, H. H.: Surg. Gyn. and Obst., 1919, xxvi, 125–132.

(7) Englisch, J.: See Englisch (3).

(8) Durrieux, A.: Les diverticules de la vessie. These de doctorat., Paris, 1901

(9) Cabot, H.: Observations upon ten cases of diverticulum of the bladder. Boston Med. and Surg. Jour., 1915, clxxii, 365.

(10) Rathbun, N. P.: Notes on vesical diverticula. Sur. Gyn. and Obst., July, 1919, xxix, 28.

(11) Israel, J.: Diverticulum permagnum vesical. Arch. F. Klin. Chir., 1877, Bd. 20.

(12) Hofmokl: Ein fall eines seften grossen divertikels der Harnblase bein Weibe. Arch. f. Klin. Chir., 1898, Bd. 56.

(13) Howard, H. W.: Diverticulum of the bladder. Urol. and Cut. Review, 1918, xxii, 623.

(14) Lerche, W.: Surgical treatment of diverticula of the urinary bladder. Annals Surgery, 1912, lv, 285.

(15) Wagner: Zrutherapie des Blasen divertikels. Arch. f. Klin. Chir., 1905, Bd. 76, 1055.

(16) Hinman, F.: See Hinman (1).

(17) Thomas, G. J.: Diverticula of the urinary bladder. Surg. Hyn. and Obst., 1916, xxiii, 378.

(18) Englisch, J.: See Englisch (3)

(19) Judd: Diverticula of the bladder. Annals of Surgery, 1918, lxviii, 298.

(20) Fischer, H.: Fischer (2).

(21) Lower: Diverticula of the urinary bladder. Arch. of Surg., July, 21, iii.

(22) Watson, E. M.: The developmental Basis for certain vesical diverticula. Jour. Amer. Med. Assoc., November, 27, 1920, lxxv.

(23) Buerger, L.: Congenital diverticulum of the bladder with a contractile sphincteric orifice. Urol. and Cut. Review, xxii, November 3, 1913.

(24) Pagenstecher, E.: Verh. d. Deutsch Ges. f. Chirurg., 1904, Bd. 33, 240.

(25) Blum, V.: Chirurgische Pathologie und Therapie der Harnsblasendivertikel, Leipzig, 1919 (George Thierne).

(26) Hinman F.: Vesical diverticulum Surg. Gyn. & Obst., xxix, 150.

(27) Rathbun, N. P.: Notes on vesical diverticula. Surg. Gyn. and Obst., 1919, xxix, 28.

(28) Young, H. H.: Excision of vesical diverticula after intravesical invagination by suction. Surg. Gyn. & Obst., 1918, xxvi, 125.

(29) Young, H. H.: Transactions Amer. Assoc. Genito-Urinary Surg., 1909, iv, 121.

(30) Judd, E. S.: Diverticula of the bladder. Annals of Surg., 1918, lxviii, 298.

(31) Cabot, H.: Transactions of the Amer. Assoc. of Genito-Urinary Surgeons 1914, ix, 53.

FIBROIDS OF THE URINARY BLADDER WITH REPORT OF A CASE[1]

IRVIN S. KOLL

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Although the literature yields but few authentic reports of benign nonpapillary tumors of the urinary bladder, their occurence may be more frequent than supposed. This premise is drawn from the facts that they are of very slow growth, covering a period of from ten to fifteen years before attaining any considerable size; that they do not as a rule produce any symptoms and, last that several of the cases reported were discovered only at autopsy.

The pathogenicity is vague as in all neoplasms. Three theories have been suggested: First, development from a partially atrophied Müllerian body (Verhoogen), second, development from a hydatid of Morgagni or lower layer of the utricle (Heger), third, originating from hypertrophied bladder muscle secondary to chronic inflammation (Blum).

Topographically they are classified as periphery, submucous and interstitial or intramural. They may be either pure myomata, fibromata or fibromyomata. They are always covered with bladder mucosa and are pedunculated. The size of the cases reported vary from that of a hazel nut to one weighing 3200 grams. They are situated in various parts of the bladder but more often on the trigon.

Two types of fibromata are described, hard and soft, the former being more frequent. Histologically the hard fibroma (fibrome dur) is made up of interlacing bundles of connective tissue fibres of varying thickness, and some elastic fibres. Very few blood vessels are seen; they are arranged horizontal to the thicker fibrous bundles. The soft variety (fibrome mou) possesses collagenous fibers, more delicately distributed in bundles or forming a reticular stroma. These fibres are bathed in liquid substance, mucoid in nature. They are very vascular. The hard fibromata undergo calcification, fatty degeneration and necrosis as a result of their poor blood supply. Cavities may form and the tumor becomes cystic. Calcification is rare in the soft fibromata but in spite of the richer blood supply necrosis does occur.

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[1] Read at the meeting of the American Urological Association, Atlantic City, April, 1922.

Histologically the true myoma closely resembles the uterine myoma. The overlying mucous membrane is thin as a rule. Two cases of malignant degeneration of the mucosa are recorded.

As mentioned previously the symptoms are absent until either the tumor attains considerable size or the location is near the internal urethral orifice or over one of the ureteral openings. It is thus obvious that obstructive symptoms will develop. When the tumor becomes large, tenesmus and rectal pressure are described. Hematuria rarely occurs or, if at all, very late.

The accompanying table shows 38 cases that I have been able to collect which are considered reliable. Of these, 28 are described in more or less detail; the remaining 10 are only recorded with the histologic diagnosis.

My personal case follows:

Mrs. O, age forty-one, referred by Dr. Leon Bloch, when first seen was suffering from severe vesical inflammatory symptoms associated with marked pyuria and hematuria.

Her history was interesting dating back fifteen years at which time she said she had a "bladder hemorrhage due to falling of the womb." A curettage, perineorrhphy and hemorrhoidectomy "relieved her of further trouble for five and a half years;" then there occurred a terminal hematuria for one week, disappearing for one year; beginning again, it lasted for two weeks. Since then, or nearly eight years ago, the periods of bleeding and frequency of urination had been coming closer together. Three weeks before consulting me the desire to urinate became continuous, the "straining" and tenesmus excruciating. Large blood clots were passed several times daily. The patient appeared cachectic. Her hemoglobin was 58.

During a period of four weeks of rest and symptomatic treatment, it was impossible to make a definite diagnosis. Five cystoscopic examinations were made during this time. All that could be defined was an intensely inflammed bladder with large edematous masses surrounding the internal urethral orifice. An inflammatory mass about the size of pigeon's egg was seen at the vertex of the bladder which was interpreted as a massive edema.

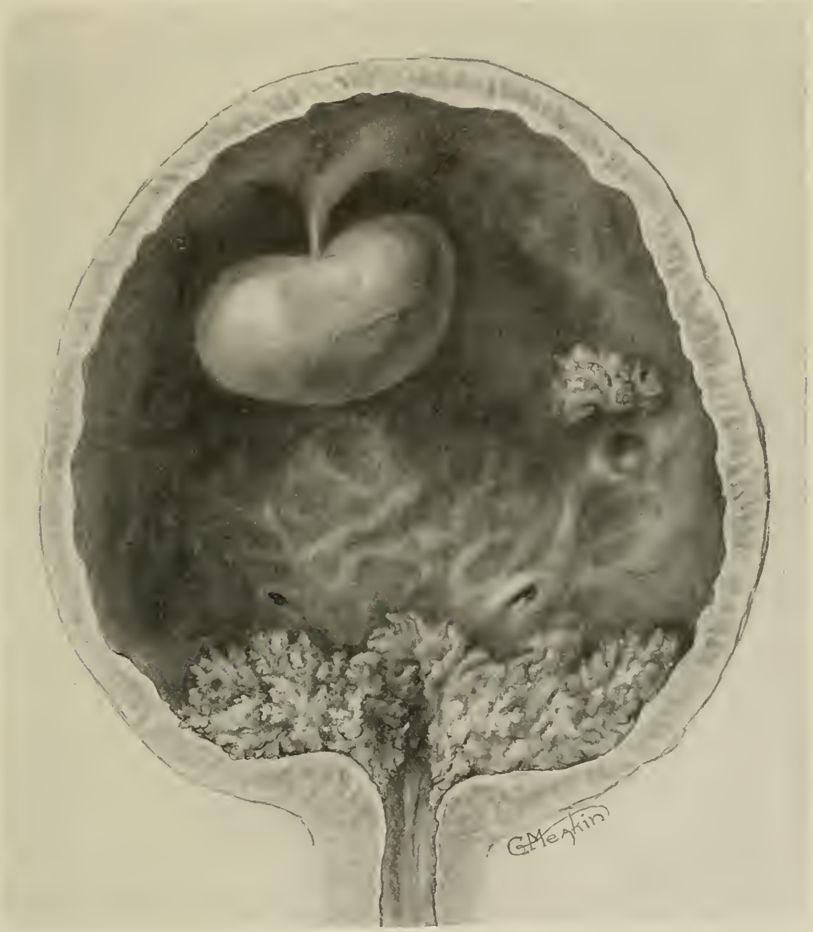

Fig. 1. Reconstructed Drawing of Bladder Findings in Author's Case

TABLE 1

Cases reported in the literature

NUMBER	AUTHOR	SEX	AGE	SIZE OF TUMOR	LOCATION IN BLADDER	HISTOLOGIC DIAGNOSIS	REMARKS
1	Blum	M	21	Man's fist	Posterior bladder wall	Myofibroma	Covered with diphtheritic membrane
2	Volkman	M	54	Lemon	Vertex, sub-mucous	Polypoid-myoma	
3	Belfield	M	50	Hazelnut	Vertex, intra-mural	Myoma	Discovered at autopsy
4	Belfield	M	74	Very small	Right ureter orifice	Myoma	Discovered at autopsy, hydronephrosis, hydroureter
5	Faye	F	41	Man's head	Posterio bladder wall, intra-mural	Fibromyoma	Discovered at autopsy, death due to infection following craniotomy
6	Tassi	F	23	125 mm. diameter	Right trigone, submucous	Myoma	
7	Polaillon	F	50	Weight 3200 grams	Submucous	Fibromyoma	
8	Gibbons	F	23	Pigeon egg	Left lower quadrant, submucous	Myoma	
9	Nicolich	M	47	Small nut	Left half trigone, submucous	Myoma	
10	Nauman	M	74	Fist	Trigone, submucous	Fibromyoma	
11	Socin	M	51	Nut	Right ureter orifice, submucous	Myoma	Discovered at autopsy, death from bilateral pyelonephritis
12	Warholm	F	28	Nut	Anterior bladder wall, intra-mural	Leiomyoma	
13	Hartman	F	60		Trigone, submucous	Myoma	
14	Marchand	M	25	8 grams	Anterior bladder wall, submucous	Leiomyoma	

15	Verhoogen	M	23		Posterior bladder wall, endoperitoneal in origin	Myoma	
16	Karlstrom	F	50		Posterior bladder wall, submucous	Myoma	
17	Ramsay	F	38		Posterior bladder wall, submucous	Myoma	
18	Riegel	F	20	Filled entire bladder cavity	Submucous	Myoma	Discovered at autopsy, death due to kidney involvement
19	Freyer	F	24	Weight 9 ounces	Submucous	Myoma	
20	Kraske			Diffuse tumor involving posterior bladder wall not admitting of radical operation		Myoma	
21	Paschkis	M	35	Fist	Anterior wall, submucus	Myoma	
22	Paschkis	F		Pea, multiple	Submucous	Myoma	
23	Wallace	F	28	Large nut	Right trigone	Fibromyoma	
24	Heitz-Boyer	F	41	9 by 4 cm.diam.	Trigone, intra-mural	Fibromyoma	
25	Judd	M	61	Weight 40 grams	Interior urethra orifice	Fibromyoma	
26	Judd	M	50	Weight 230 grams	Pedunculated, vertex	Fibromyoma	
27	Sims	F	3	3 ounces	Interior urethra orifice	Myxo-fibroma	
28	Koll	F	41	Large pecan	Pedunculated, vertex	Fibroma	
29	Lauterman	F	41	Bean	Pedicle at vertex	Fibromyoma	

The following (Cited by Verhoogen, Encly. D'Urol. Francaise, iv Chap. vi) report cases with only histologic findings: Davis, 1 myoma; Crick, voluminous fibroma in child of 5; Verhoogen, 2 myomata, 1 fibroma; Watson, 3 myomata, 1 fibroma.

The patient was allowed to leave the hospital, somewhat improved subjectively, the pyuria and bleeding much less pronounced. After a month of unsatisfactory results at home she returned to the hospital. Another cystoscopy was done with both the Buerger cysto-urethrascope and cystoscope. It was now possible to diagnose definitely a large papilloma completely enveloping the internal urethral orifice and two smaller papillary tumors higher up. Also a pedunculated neoplasm was well defined attached to the bladder wall at its vertex. It appeared smooth and was tentatively called a benign non-papillary growth.

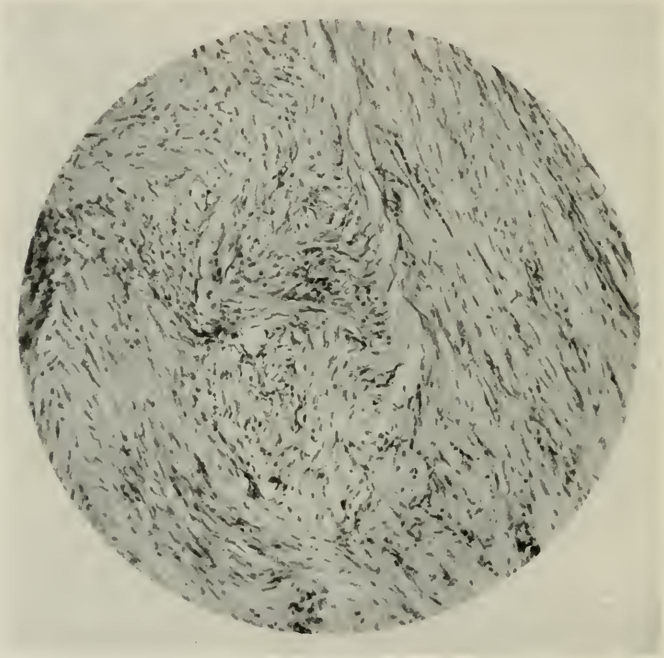

Fig. 2. Microphotograph of Section of Bladder Fibroma (Author's Case)

The bladder was opened the papilloma removed digitally, the pedicle of the solid tumor cut and all the bleeding points controlled with the diathermic applicator. There was no further hemorrhage during convalescence or since. The patient was very ill from an ascending bilateral pyelonephritis with a temperature persisting for many days around 104°F. She was discharged from the hospital on the forty-ninth day after the operation. A small fistula persisted which was discharging considerable urine; this fistula has only recently closed, nearly one year since the operation.

At intervals of from two to four weeks the remaining papillomatous tags have been fulgurated and the bladder now is practically free of any pathology.

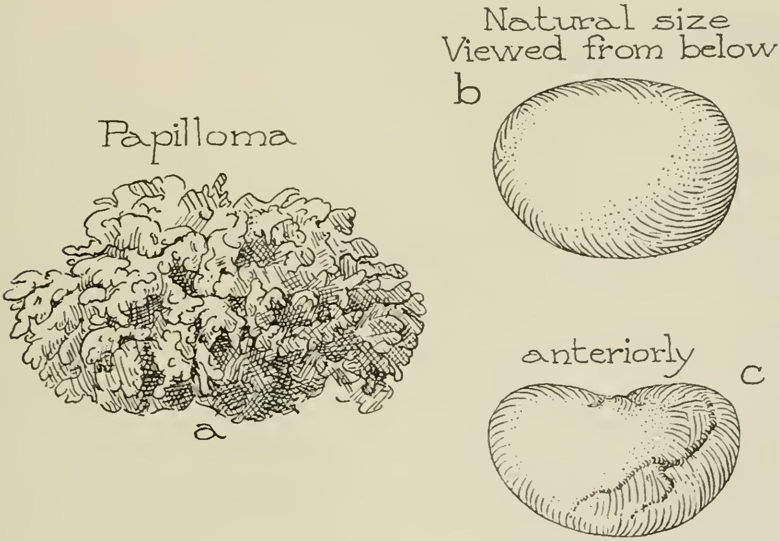

Fig. 3

Following is the report of Dr. O. T. Schultz, pathologist to the Michael Reese Hospital:

Contents of bladder: Gross; a large amount of pale, friable papillomatous tissue, in masses of variable size, the largest 5 x 3 cm. There is also an ovoid smooth mass 3 x 2 x 1.5 cm. On section the latter is pale, translucent and rather firm; the capsule is partly incrusted by salts.

Microscopic: The papillomatous material itself does not appear malignant. The ovoid solid mass is composed of dense fibrous tissue which is somewhat edematous. There is no covering epithelium. A thin superficial layer of tissue is necrotic and is infiltrated with lime salts.

One must logically conclude that the symptoms in this patient were due probably entirely to the papillomata, but the accurate history obtained plus the combined finding of the two different varieties of neoplasm prompted the detailed citation of the case.

REFERENCES

Davis, L. Primary tumors of the bladder. Ann. Surg., April, 1906.

Zukerkandl, Blasenmyome: Ref. Wien. Klin. Woch., 1908, no. 8, 271.

Heitz-Boyer-Dore: Tumeurs musculaires lisses de la vessie. Ann. des Org. Gen. Urin., 1910, xi, 2115.

Blume, V.: Das Myofibrome der Harnblase. Folia Urol., 1910–1911, 314.

Ghedini, A. H.: Contributo alla cura chirurgica dei neoplasmi dell' uricesti. La Clinica Chir., 1910, x, 1938.

Davis, L.: Clinico-pathologic data on bladder tumors. Boston Med. and Surg. Jour., clxiv, 222.

Heineke: Tumors of the bladder. Zentrlbl. f. Chir., 1913, xl, 923.

Judd: Non-papillary benign tumors of the bladder. Jour. Lancet., Minneapolis, 1914, xxxiv, 188.

Casper, L.: Tumors of the bladder. Med. Klin., Berlin, 1914, x.

Bollag: Study of tumors of the bladder. Rev. suisse de med., 1914, xiv, no. 16.

Robitshek: Primary tumors of the bladder in children. St. Paul Med. Jour., 1914, xvl, 580.

Gronberger, G.: Case fibroleiomyoma of bladder. Nord. med. Ark., Stockholm, 1914, xlvii, no. 27.

O'Neil, R. F.: Bladder tumors in the young. Boston Med. and Surg. Jour., 1915, clxxiii, 873.

Watson: Review of 653 bladder tumors. Ann. Surg., 1905, xlii, 805–830.

Watson: Tumors of the bladder. Boston Med. and Surg. Jour., 1884.

Ceci: Myomes be la Vessie. Ann. d. Mal. des Org. Gen. Urin., xv, 225.

Guyon: Anatomie et Pathologie des Neoplasmes de la Vessie. Idem., 1903, xxi, 1440.

CONSIDERATION OF PROCEDURE IN THE SURGERY OF THE BLADDER[1]

JOSEPH F. McCARTHY
New York

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This communication concerns itself solely with the question of approach to and delivery of the urinary bladder in the male as well as the better delineation of procedures such as resection, ureter recognition, implantation, etc. It does not consider the question of scalpel or cautery resection, or of the value of the procedure. Rather it recognizes these operations as a matter of current usage at the hands of representative urologists, either in conjunction with or independent of desiccation, radiation, or the high voltage ray. The writer would like to go on record as stating that even though this procedure be entirely dispensed with in resections for bladder tumors, it will and should be taken up for the more complete and the more surgical applications of radium and thermic penetration, and at the same time, afford better protection to the adjacent structure such as the rectum and vagina. Nor can he escape the conviction that the present practice of such applications through the ordinary suprapubic incision will never be productive of results such as may be obtained by the complete exposition of the bladder as shown in the accompanying illustrations. There is little of novelty in these pictures save completeness and they are based upon observations of the work of Squier and others, a considerable measure of personal experience, as well as extensive cadaver study. The question it asks is: How may these steps best be taught? It is the anticipation of the writer that if it conveys nothing of import to his auditors, it will at least enlighten him. The subject matter under this title including as it does more than fifty half-tone illustrations, offers many difficulties in its presentation in abstract form.

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[1] Read at the meeting of the American Urological Association, Atlantic City, April, 1922.

The first series of illustrations projected on the screen and which are not here presented because of the limitations of space, were shown with the object of emphasizing the necessity in suprapubic cystotomy of the avoidance of unnecessary mobilization of the bladder, especially the importance of refraining from undue separation of the cellular planes on either side of the bladder antero-laterally, for the reason that technically, such steps are entirely unnecessary and the added risk of sepsis entailed in this unnecessary separation. While deliberate resections of the bladder have been performed as far back as 1885, it nevertheless remained for my colleague, Dr. Squier, to place these procedures on a firm surgical footing.

HISTORICAL

In 1874, Billroth performed the first bladder operation for myosarcoma. Successful removal of growth the size of a fist on a boy of twelve. Recovery. Volkmann, secti alta for a vesical myoma. Died third day post-operative. In 1880, Sir Henry Thompson, Whitehead and Guyon, performed this operation by perineal route. In 1881, animal experimentation by Fischer (Arch. fur Kliniche Chirurgie) demonstrated the feasibility of bladder resections. In 1885, the first real bladder resection in man was done by Sonnenberg, who incised the peritoneum and resected the upper two-thirds of the bladder. Antel of Bada Pesth, rejected resection of the bladder with incision of the peritoneum because of septic infection and recommended subperitoneal resection of the bladder, which he practiced successfully in 1885. He advocated separation of the peritoneum from the bladder by blunt dissection before opening the bladder. Applicable, he stated, to growths on upper and lateral walls. Wound not sutured

In Sonnenberg's case, the peritoneum was incised to a wide extent and sutured. Vesical cavity was drained but not sutured. Patient died after four weeks and autopsy revealed a new formed bladder space made up for the most part with peritoneum lined by epithelium and capable of good distention. In 1888, Rydygier (Wiener Med. Wochensch.) performed the first deliberate transperitoneal resection of bladder and based his operation upon the agglutinating property of the peritoneum, as well as animal experimentation. The above operation was performed for the removal of a large calculus. He carefully sutured in tiers and stated that he anticipated good results from this method for operation upon malignant vesical growth, as the neoplasm could be removed with a portion of the bladder wall itself. In 1898, literature by Wendel (Beitrag Zur Klin. Chir.) revealed 10 extirpations of the bladder and 55 partial cystectomies. In 1887, Bardenhauer performed the first total cystectomy. Outcome fatal. Fifty-five resections. 45 carcinomata. 6 sarcomata. Majority of cases concerned tumors of anterior or lateral walls. In 1893, Harrington performed transperitoneal cystotomy for removal of bladder growths. In 1908, C. H. Mayo advocated transperitoneal removal of bladder tumors, at the same time he stated, the bladder can be raised with tenaculum forceps and resected with a pacquelin cautery. In 1913, Judd recommended transperitoneal removal of malignant growths where accessible. In 1914, Squier recommended extra-peritoneal mobilization of the bladder. In 1917, Beer advocated cautery excision of vesical growths.

The accompanying illustrations but sketchly represent a few technical refinements and emphasize certain important anatomical considerations. They are presented with a view to standardizing the technique of these operative steps.

Figure 1 shows the customary median incision which should be carried from the middle of the symphysis up to and beyond the umbilicus. With wide retracton and a collapsed bladder the next step is the separation of the peritoneum below from the dense fascial layer above, followed by section of this as illustrated in figure 2. This is a valuable aid in mobilization of the bladder. In figure 3, this step is complete. Figure 4 illustrates a point the writer deems desirable for greater facility in subsequent resection, that is, the separation of the bladder from the lateral walls and is carried well around and some distance on the inferior aspect of the organ. This enables definite stabilization of the parts as shown in figure 5. The urachus above should be fixed as well as its point of attachment with the bladder below, clamps being placed on either side. In the writer's opinion, the step here indicated, cutting of the superficial fascia, is the most important procedure in the entire operation and if carefully performed on either side of the urachal attachment, the operator is enabled at once to approach the peritoneum after which one may cut the urachus with a scalpel or insert a clamp above and below using the lower one for traction. Figure 6 shows this step complete on one side. In figure 7, is seen the technique of separation which is best carried out by moist gauze. The same step is completed on the other side of the urachus and when completed one observes the continuation of the separation as shown in figure 8. Figure 9 indicates the method of freeing the bladder from its lateral attachment by cutting. The attachment here is rather dense and ligamentous. The writer believes that the obliterated hypogastrics do not offer as much value in the guidance of the operation at this point as was thought some time ago and feels that for the most part, it should be disregarded. Figure 10, illustrates the separation of that portion of the bladder intimately adherent to the perineum and the adjacent structures. This is the only difficult part of the operative procedure as while the separation up to this stage is difficult, delivery of the bladder in its further steps is extremely easy. From here on the attachment is of areolar connective tissue type. See figure 11. The separation may be carried still further as illustrated, both hands dipping deeply into the wound and carrying the separation with considerable freedom, as there is little liability of damage at this point. Figure 12 reveals the completion of this step, the bladder delivered shown at the lowermost aspect of the incision with clamps attached. It is of advanage at this stage to identify the ureters, and if the reader will observe the transverse elevation at the lower part of the bladder, the complete identification of the ureters on either side may readily be accomplished by applying Allis clamps along this ridge which is the extra-vesical reflection of the inter-ureteric band and traction on it must skeletonize the vesico-pelvic fold in which the ureter is situated. These vesico-pelvic folds are well depicted in figure 13, which also demonstrates the feasibility of freeing the organ laterally and inferiorly. This practice is not however, recommended as a routine procedure. In the vesico-pelvic fold is to be observed the ureter and the vas at the point where the latter slips below the former to approach the vesicle. Figure 14 reveals the practical method of separating the bladder after the peritoneum has been accidentally or intentionally opened. Here one sees the fingers of the operator separating the bladder below from the peritoneum above, the latter is subsequently cut away from the bladder when the separation has been completed to the midline (fig. 15). When the bladder has been separated intraperitoneally the next step is the closure of the peritoneum and the continuance of the operation as in the extra-peritoneal method. Figure 16 illustrates the proper point of opening of the bladder on the posterior aspect, to conserve as much of the organ as possible for subsequent repair, in cases where the growth is situated in its customary site, postero-externally to one or the other ureter. Figure 17 delineates the act of picking up of the ureter and also reveals very distinctly the previously mentioned fold analogous to the inter-ureteric band, traction on which will bring the ureter into view. The ureter may also be located higher in its course at the outer edge of the sacral promonotory. Figure 18 represents the resection of the bladder growth. The writer believes it is well to identify and separate the ureter when the nature of the growth has been fully determined upon and the necessity for such resection proven. The writer is not in accord with the removal of the growth without this identification and segregation of the ureter. Figure 19 illustrates the advantage of the grooved director in cases where there has not been marked hydro-ureter. It is a very useful instrument in this connection, simplifies the procedure, and in the extra-vesical fixation as shown in figure 20, facilitates the accomplishment of this step without the danger of transfixion of the opposite ureteral wall. The final figure illustrates in a general way the process of repair and the location of the drainage tube, which does not constitute a part of the original bladder incision. As indicated by Squier, the subsequent attachment of the cut urachus to its peritoneal half is desirable for purpose of restoration.

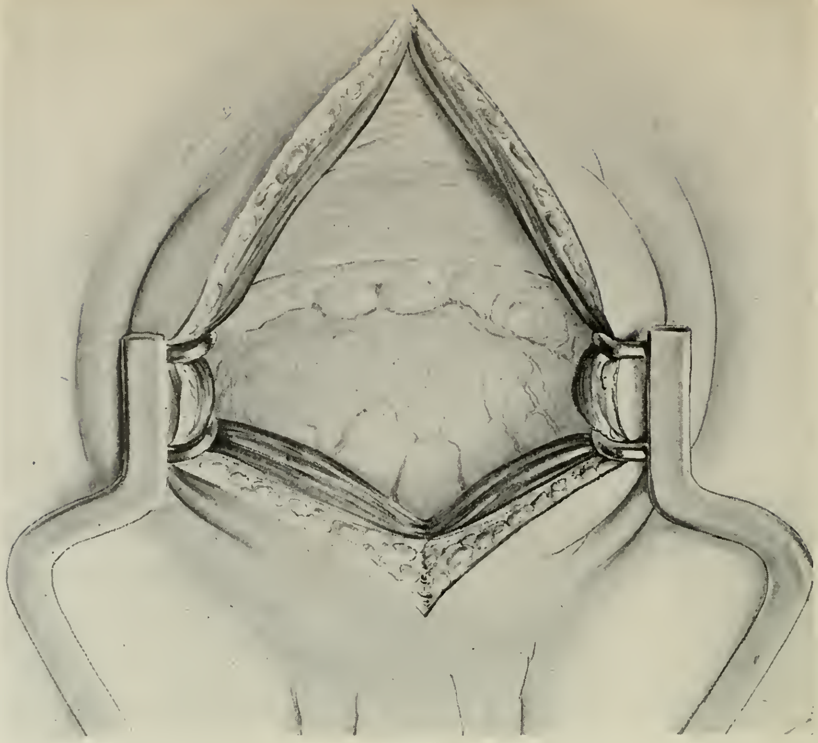

Fig. 1

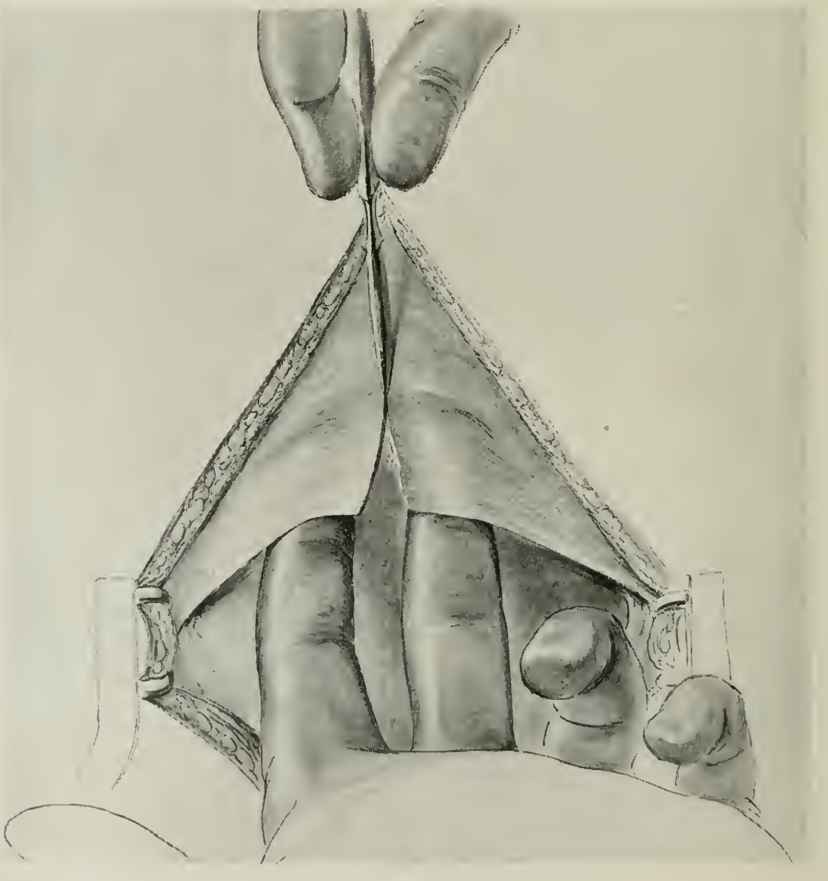

Fig. 2

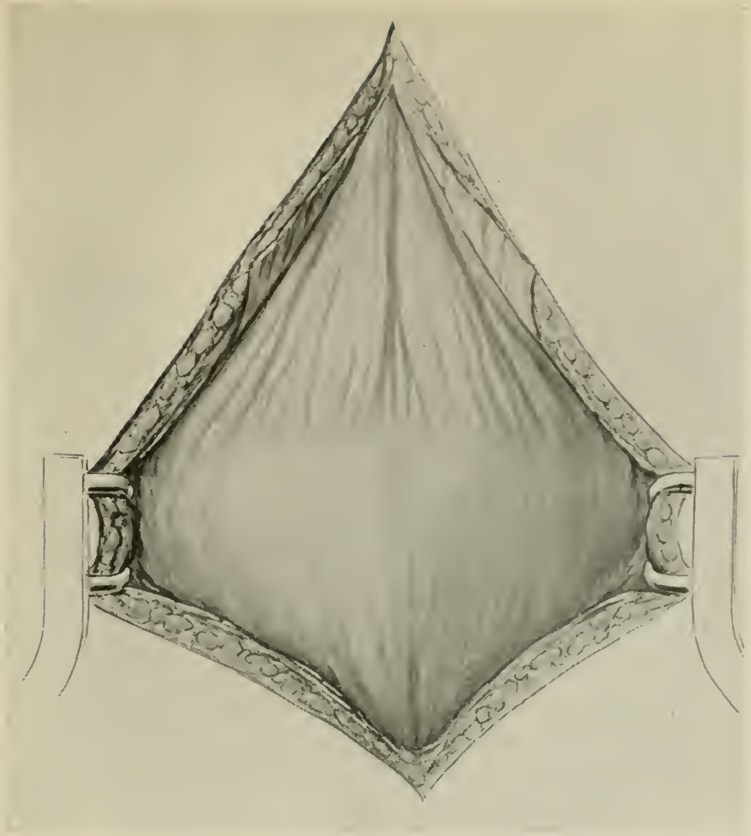

Fig. 3

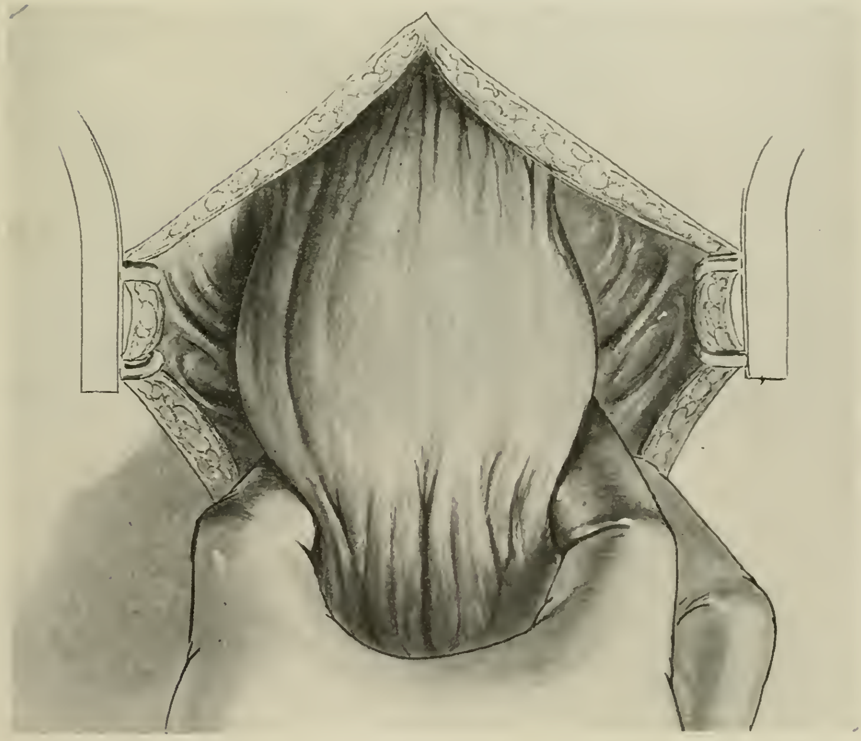

Fig. 4

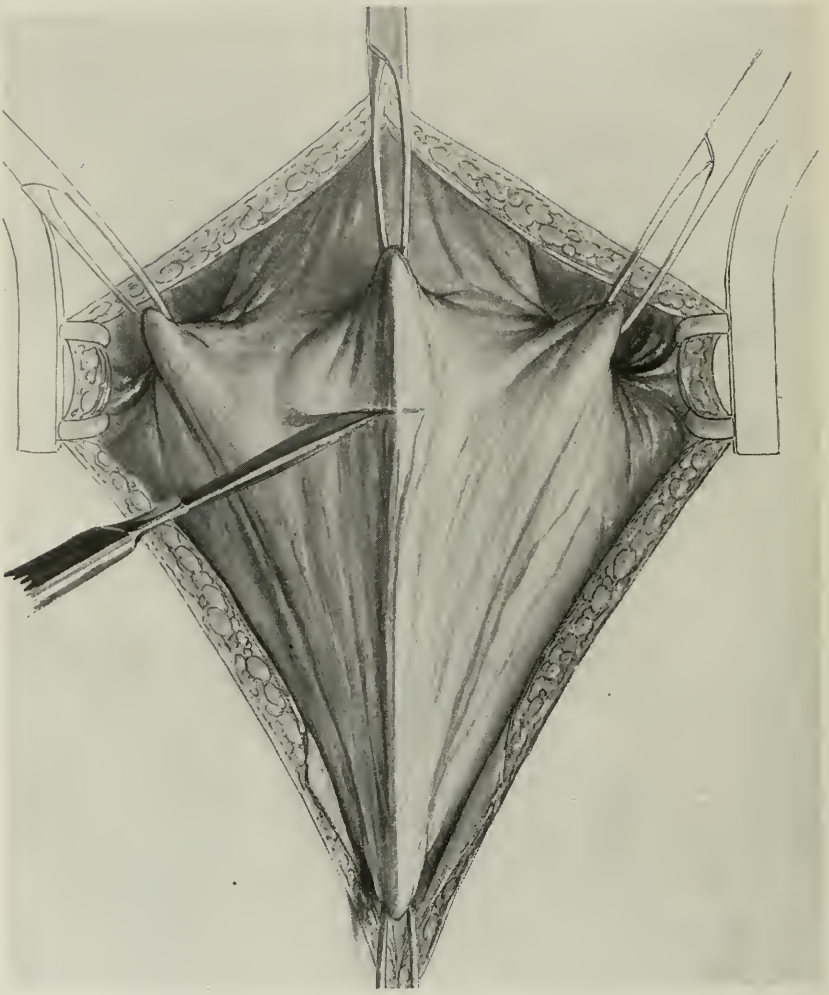

FIG. 5

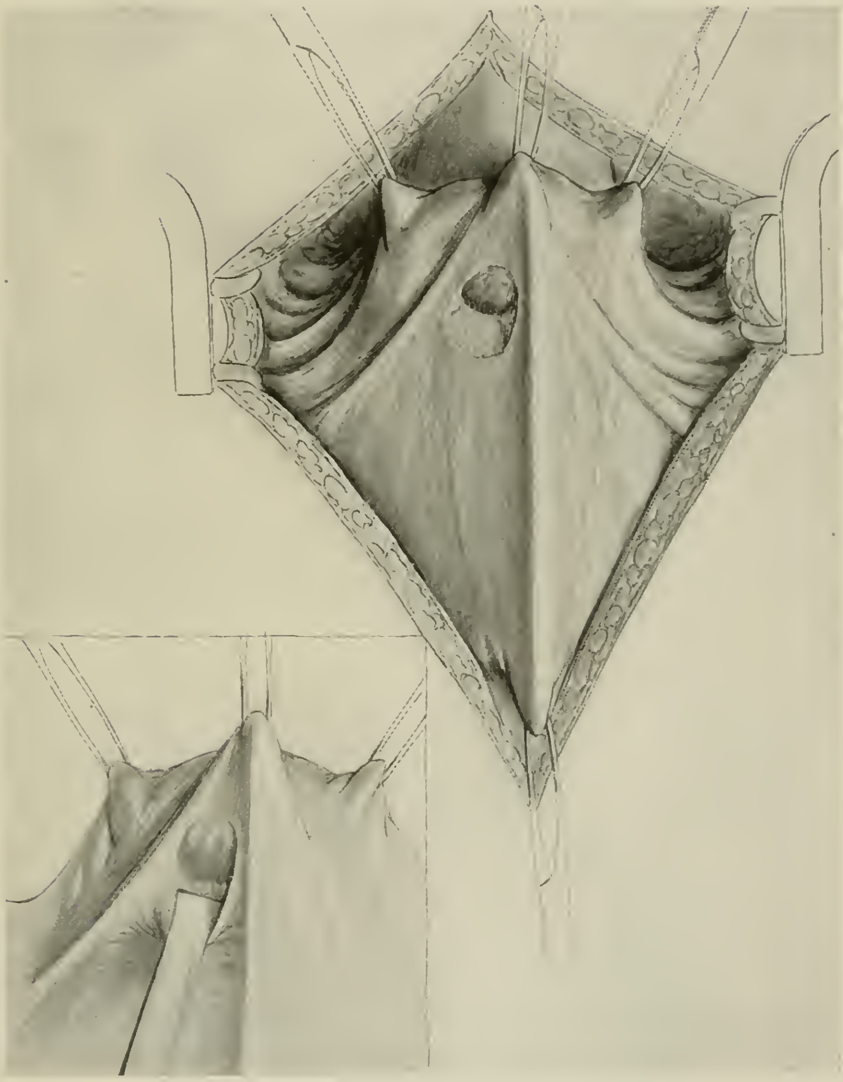

FIG. 6

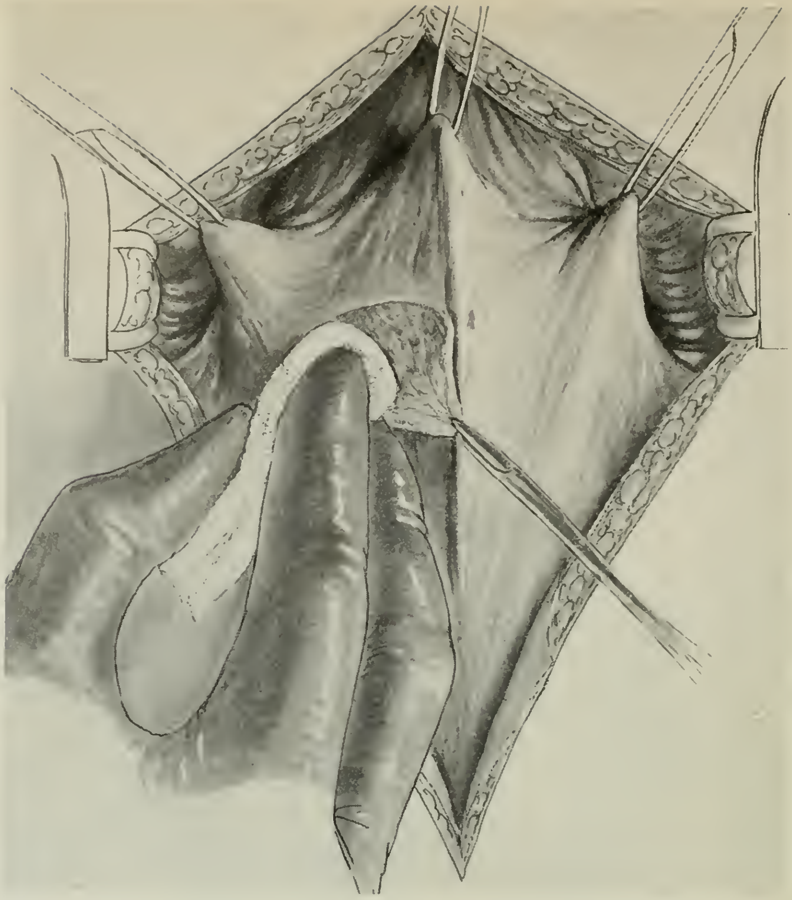

FIG. 7

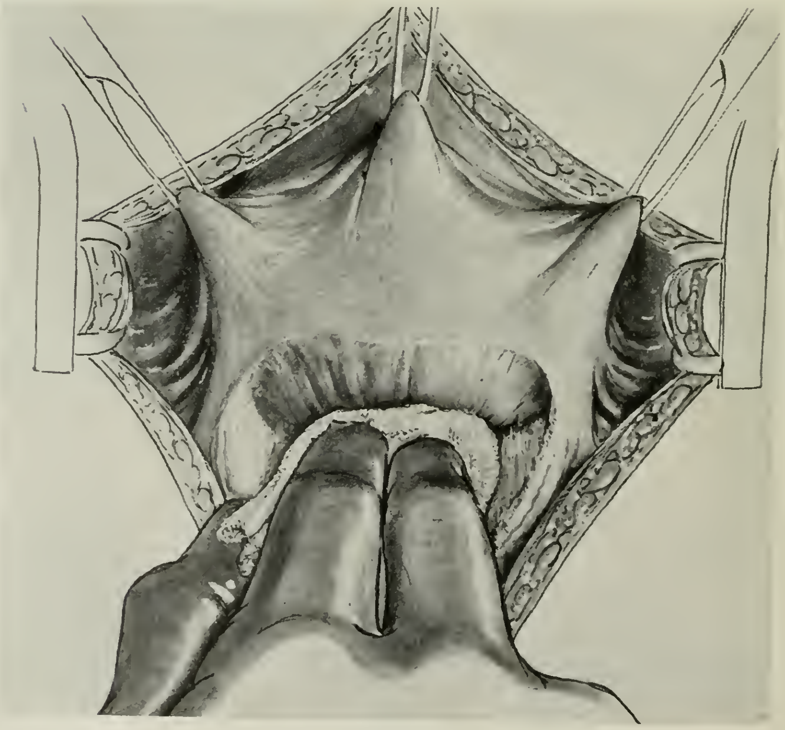

FIG. 8

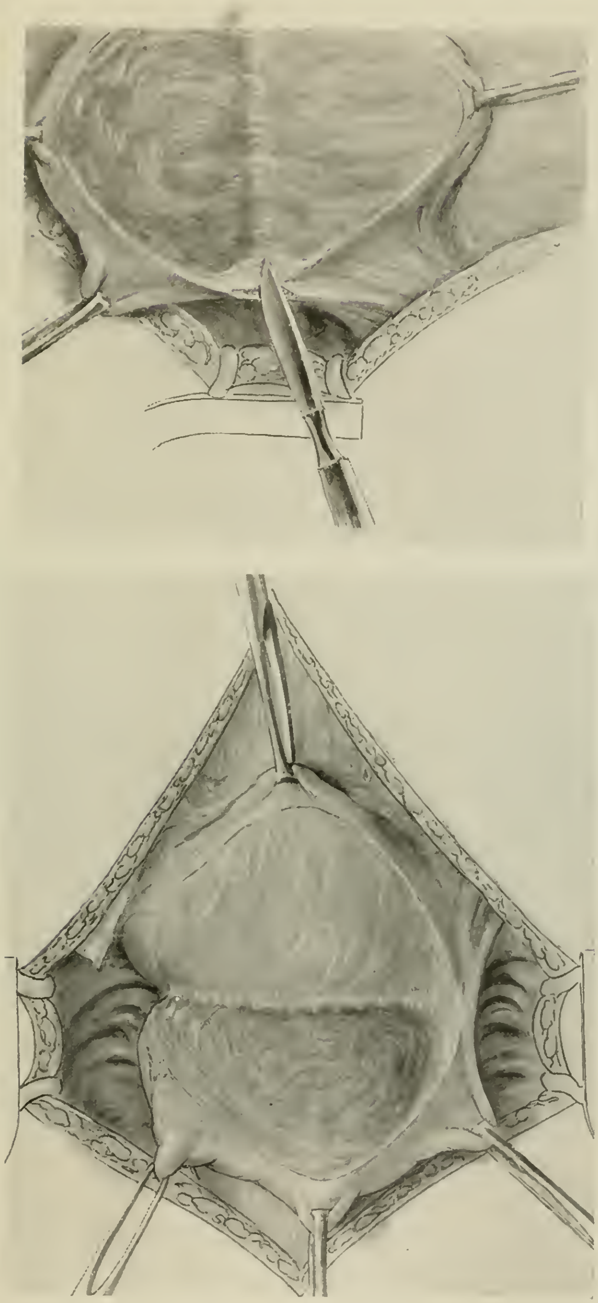

FIG. 9

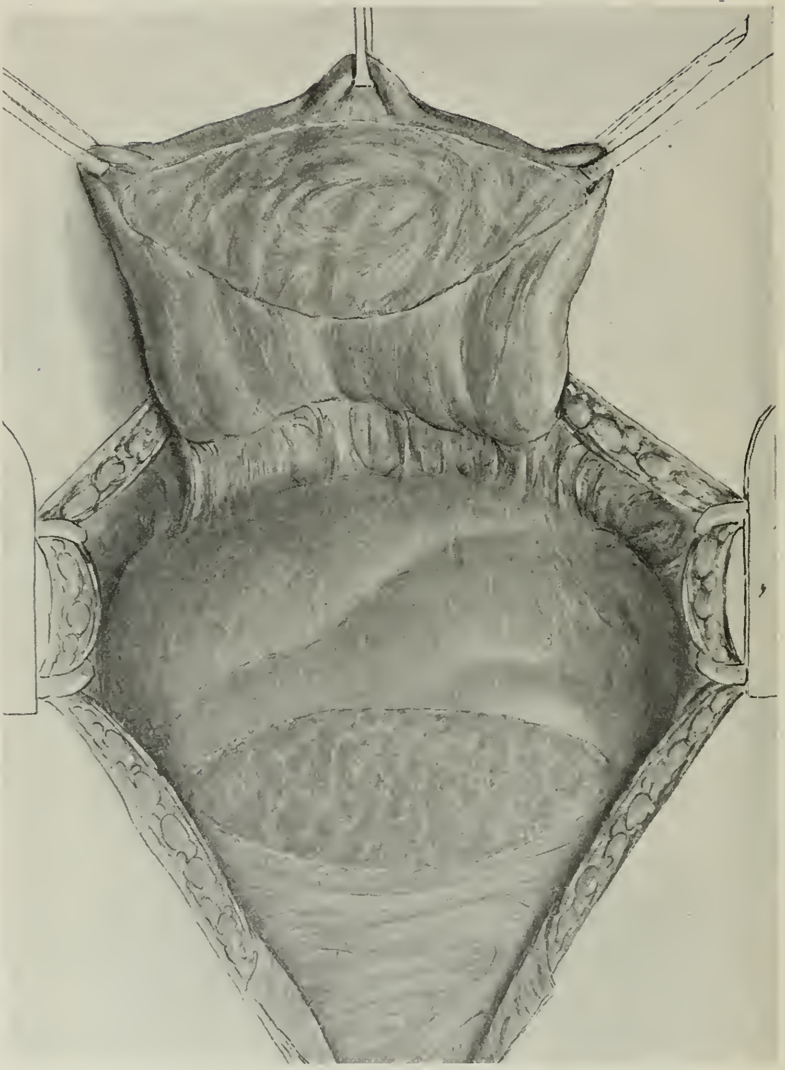

Fig. 10

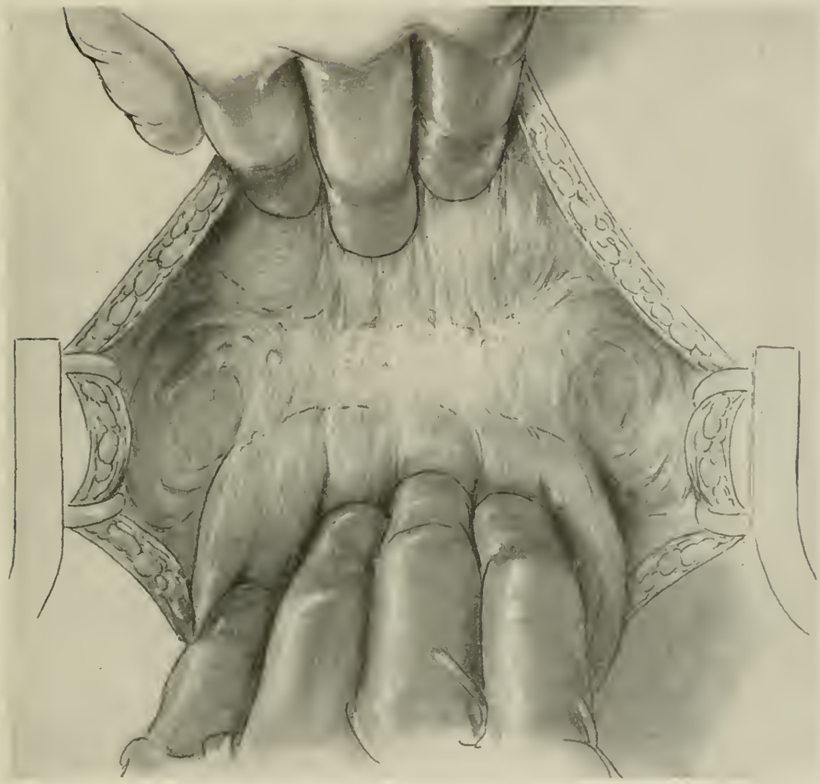

FIG. 11

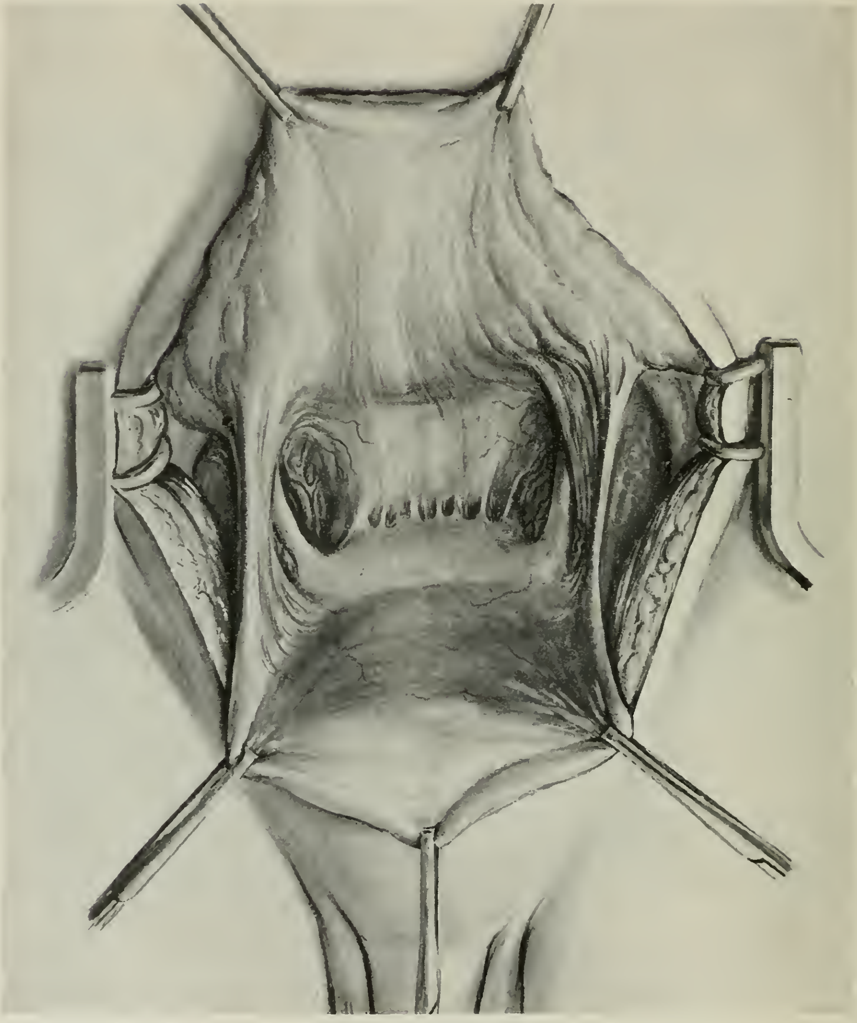

Fig. 12

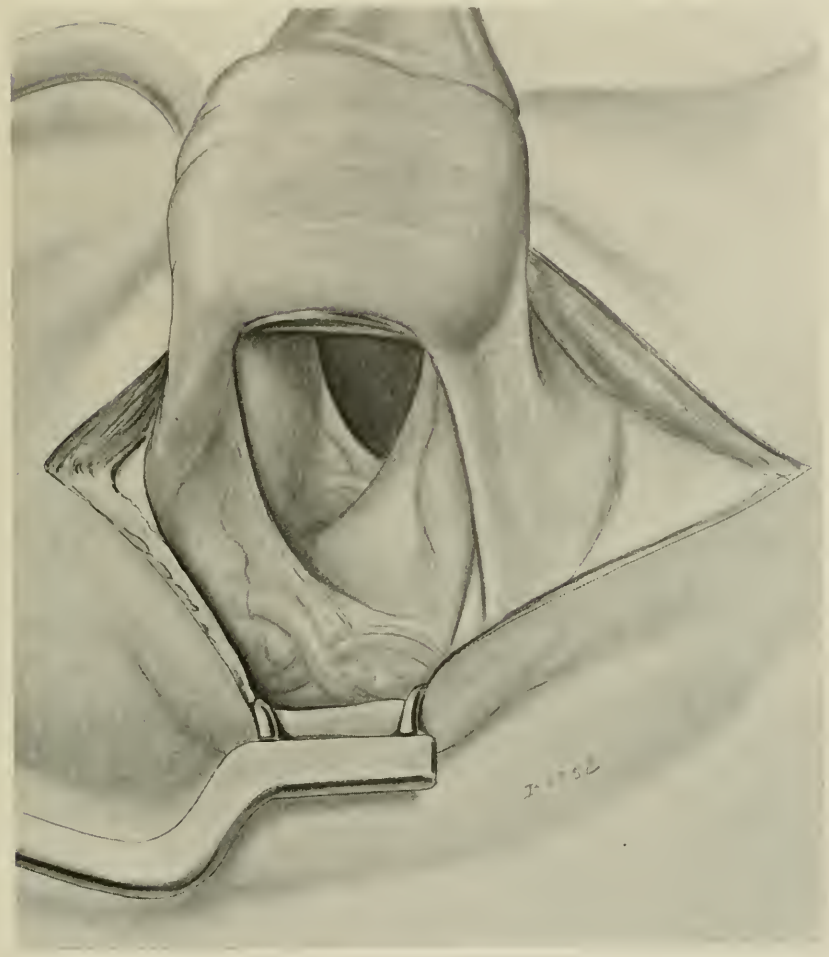

FIG. 13

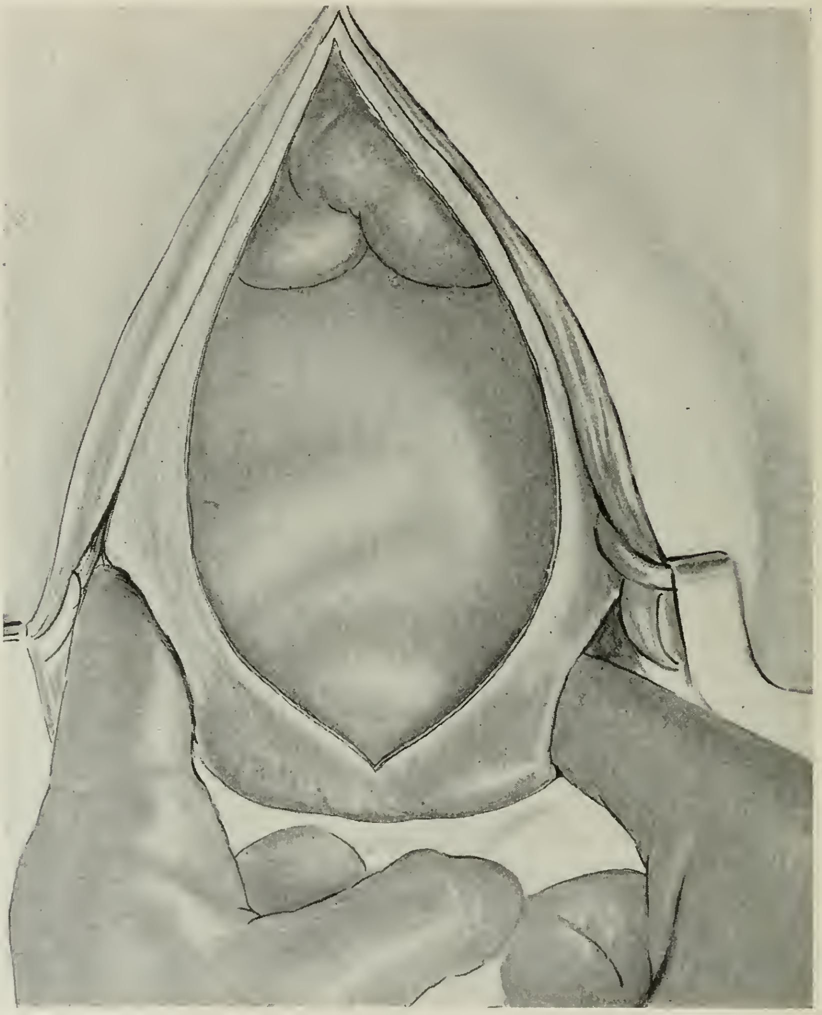

FIG. 14

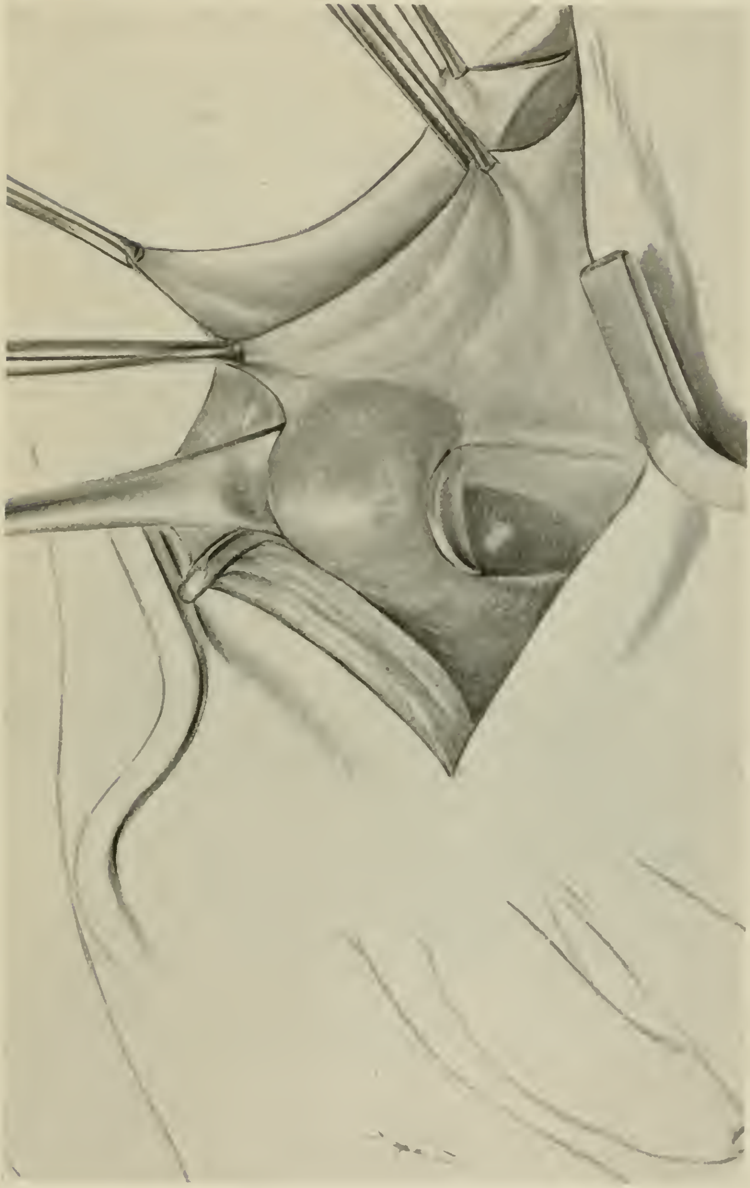

FIG. 15

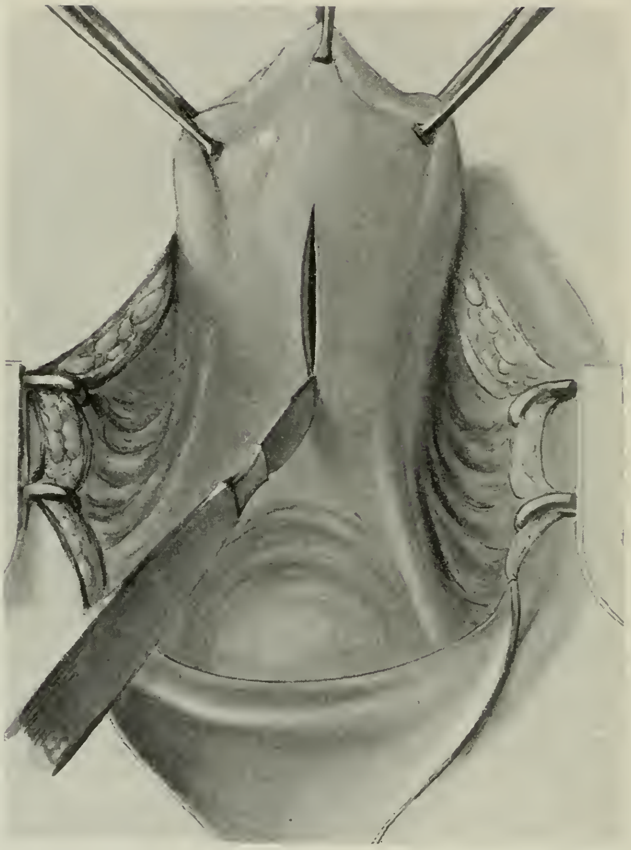

Fig. 16

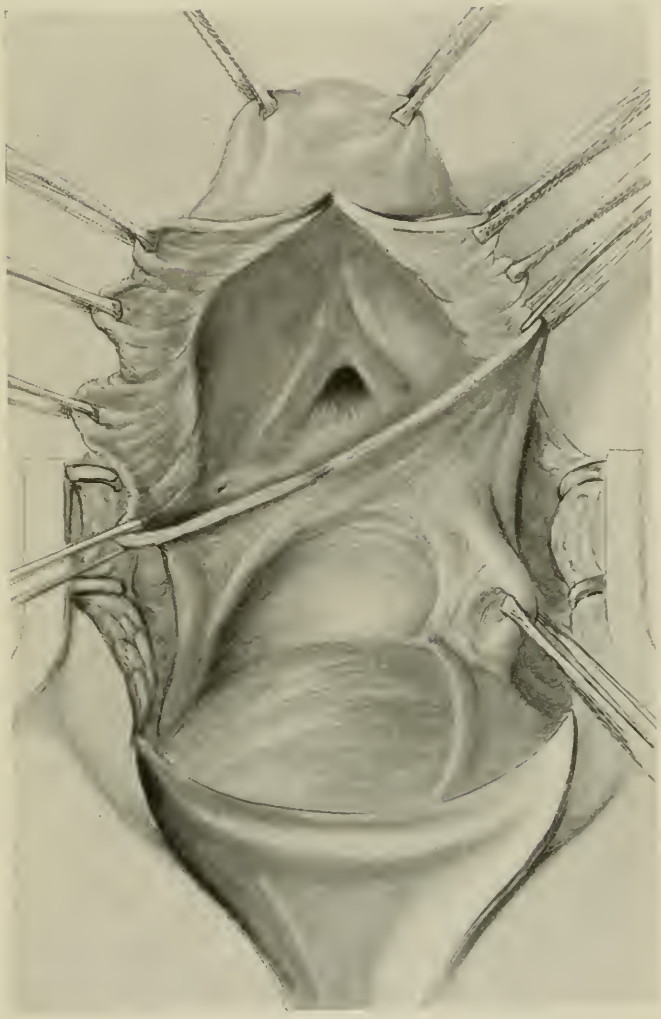

Fig. 17

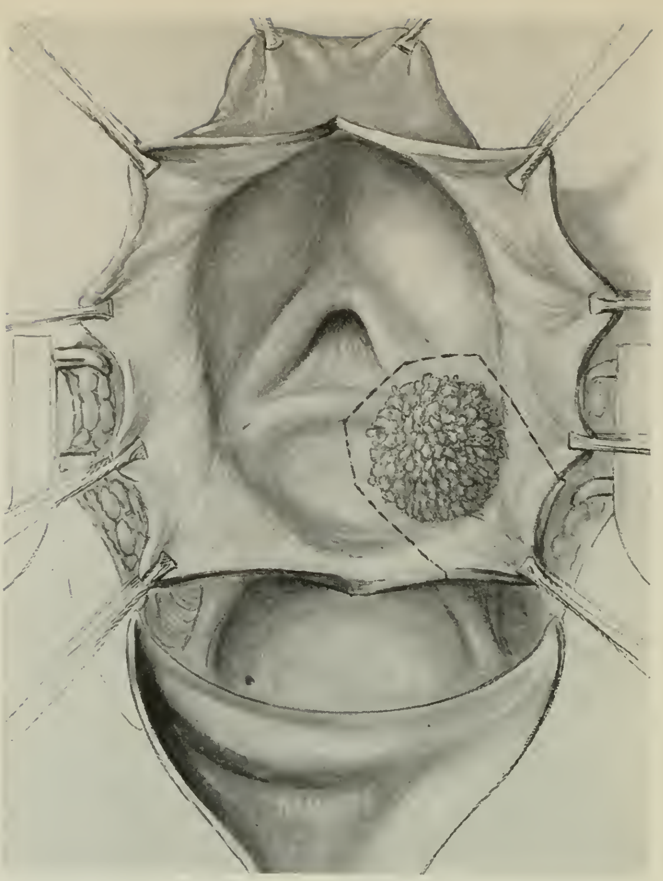

Fig. 18

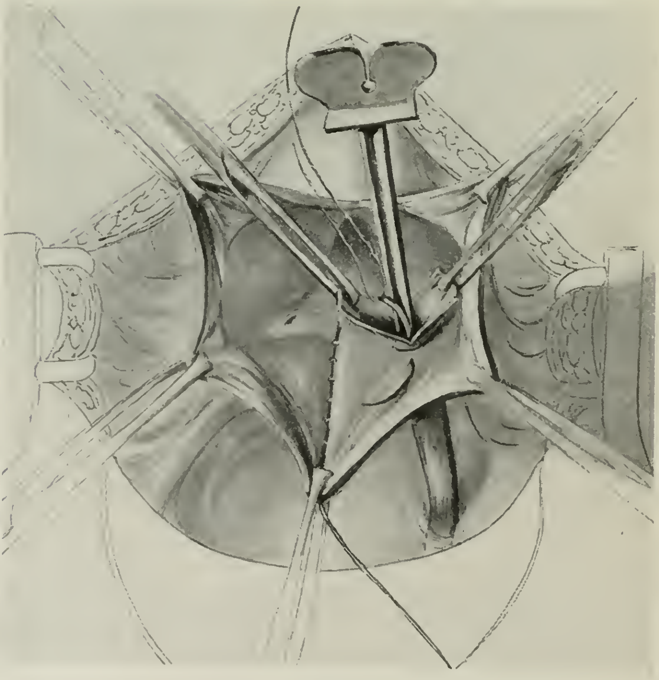

Fig. 19

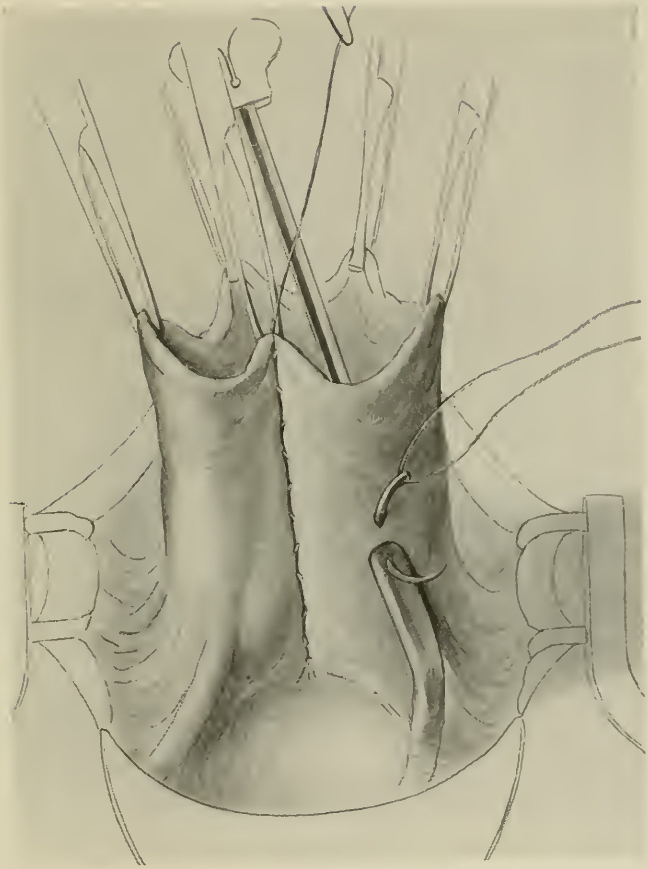

Fig. 20

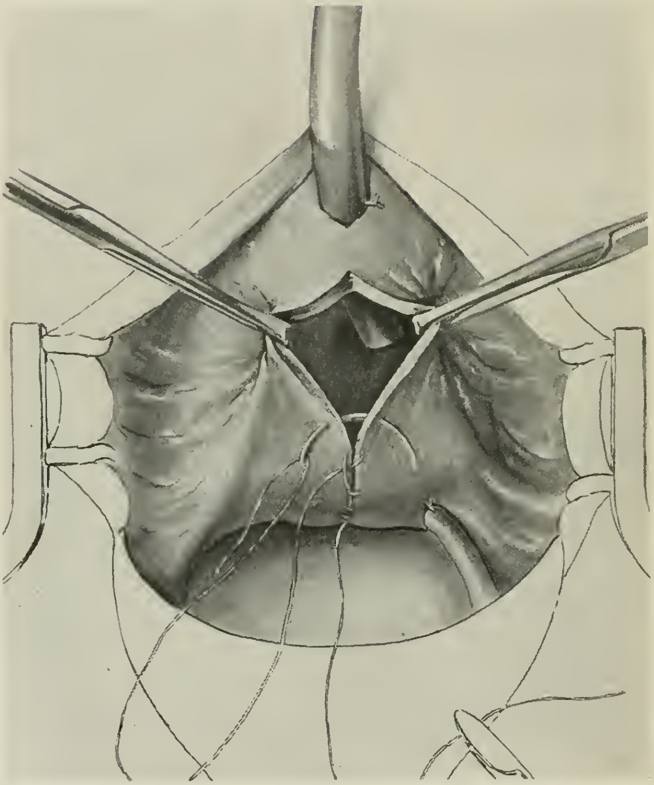

Fig. 21

DISCUSSION

Dr. James A. Gardner, Buffalo: The paper of Dr. Hyman interested me very much because of the difficulty of recognizing diverticula in the young, and I was exceedingly pleased with the results he got with his pyelograms with these youngsters. I had not thought of it before, but viewed from the lateral side in the young we apparently get a much better view than we get in the adults.

I have thought for many years that diverticula were acquired, with a history of obstruction, but with these youngsters certainly it swings back to the other side and as we realize more and more that care in diagnosis will bring out these diverticula in the young, we will doubtless have to concede that the majority are congenital rather than acquired, although personally I had not, up to this time, felt that this was a fact.

Dr. W. C. Quinby, Boston: I wish to report two further cases similar to those interestingly related by Dr. Chute. One was the result of trauma in an automobile accident in which a boy's leg was crushed, necessitating amputation. As a secondary affair there occurred also a rupture of the urethra at the inner surface of the triangular ligament, above the levator ani muscle. This was followed by extravasation of urine around the bladder rather than in the perineum, apparently the result of separation of the symphysis with tearing of the urethra, rather than fracture of the pelvic bones. A gangrenous pericystitis such as Dr. Chute has described, was found in this case.

The second case followed over-zealous instrumentation in a patient suffering from an hypertrophied prostate. Here there was no extravasation below the triangular ligament but just at the neck of the bladder above the levator muscle.

The anatomical relation of the levator ani muscle to the tear in the urethra causes the distinguishing feature in these cases. If the leakage is above the muscle one gets a pericystitis: if below one gets suppuration in the perineum; this being the condition commonly seen where extravasation occurs behind a stricture. In one of Dr. Chute's cases both were present.

Concerning Dr. Hyman's exceedingly interesting report on diverticula in babies, we all have ideas regarding the nature of these pouches. Mine has always been that the diverticulum is congenital, in a very considerable number of instances at least, and where the diverticulum is quite large. Though it exists during infancy it is not recognized because it causes no symptoms until some additional factor intervenes, most commonly infection. Then the diverticulum makes itself evident, and if observation and diagnosis is sufficiently accurate a sac will be seen. If not, the baby will be treated for intussusception, pyelitis of infancy or what you will.

In other words, I feel with Dr. Hyman that a large proportion of the diverticula we see in the adult are at least potentially present at birth, and are developmental faults. Of course some are acquired, but I think not many.

I have had no experience with fibroids of the bladder described by Dr. Koll.

Concerning Dr. McCarthy's very illuminative address, I can only express my appreciation. There are certain surgical measures that are accepted by all. The fundamental thought today, I think, is that if one is operating on the bladder it makes no real difference whether one remains outside the peritoneal cavity or not. It depends upon conditions in the individual case such as the amount of perivesical infiltration, as to whether it is easier to open the peritoneum and separate the bladder in that way, or to separate it without opening the peritoneum. The bladder should be well freed under any circumstances but this procedure is not dependent upon opening the peritoneum. There is plenty of room if one stays entirely outside the peritoneal cavity, so that even if we have to excise the entire bladder it is not necessary to open the peritoneum. Whether we open or not depends entirely upon the circumstances in each individual case.

DR. BRANSFORD LEWIS, St. Louis: The question as to whether these conditions are acquired through obstruction, or are congenital is not, I think, proved by the fact as to whether they are found in a child or an older person. This was illustrated by a patient of mine, a boy a little less than three years old, who had one of the most remarkable obstructive conditions at the neck of the bladder that I ever saw, even including those in middle life. This little chap for months and months before being brought to me would strain at urination, get red in the face and go through all the contortions you are familiar with in the presence of marked obstruction. Then his doctor, a very intelligent man in his city, began to catheterize him and got a lot of residual urine. Finally this was so troublesome that whenever he wanted to draw any urine he had to anesthetize the boy. The child was in a desperate condition and at less than three years of age. The patient was brought to me and I opened up the perineum and felt the tight ring of stricture surrounding the neck of the bladder just as definitely as in older individuals. I incised this and the boy made a complete recovery. This shows that there are obstructive conditions in early life just as definitely as in adult life. I have had other cases in which the history given by the parents related to obstructed urination from childhood up to twenty or forty or more years of life.

Dr. Guy L. Hunner, Baltimore: I was very much interested in Dr. McCarthy's surgical procedures on the bladder, my own experiences being limited to partial excision of the bladder for interstitial cystitis or similar conditions. I may have misunderstood Dr. McCarthy but I thought he warned us about leaving too much space around the space of Retzius, for fear of future infection, but this he did not carry out in his pictures. He went down around and behind the bladder and exposed everything in in that region. I think the pictures are the correct representation for getting at the bladder tumors, or anything of that kind, for it is very necessary to get all the exposure you need. I am discussing this because Clark and Keen in their bladder work say that they open the bladder first and outline the portion they need to dissect and then take care of that as best they can. I think this way Dr. McCarthy has represented of getting your bladder completely freed on all sides and behind before beginning work is the proper one. In the first place, you save a lot of bleeding. In cutting down on the sides you find the middle vesical artery and tie it to low down in the ureteral region, and that saves a lot of bleeding.

Dr. McCarthy's paper also showed where the chief difficulty comes, and just where the urachus comes down over the vertex of the bladder, and I have found that you can best leave that until the last part of the freeing. After freeing the sides you can round them under down around the utero-vesical fold, and free the base, and then come up around the top and take care of the urachus last. If you try to push the urachus and ligaments back you are almost sure to get into the ulcerative area. These are such thick inflammatory conditions and so often extend into the peritoneum that you cannot get around them from the side. If you try, you will get in to the peritoneum or into the bladder itself because all the parts are frozen so tight together. If you do get into the peritoneum it is best to take out all the inflamed portion and then proceed as Dr. McCarthy has indicated.

Dr. Clarence G. Bandler, New York: I would like to report a case of diverticulum of the bladder in a child three years old, who was admitted to the Presbyterian Hospital on March 1, 1922. The child had been in the hospital, a year before, with a diagnosis of rickets and stricture of the urethra. At that time he was cystoscoped and a trabeculated bladder was also noted. Three months before the present admission to the hospital, the lower half of the abdominal wall was scaled, resulting in a severe burn, which healed rather slowly. About a month before this accident the father had noticed a swelling about ½ inch below the child's umbilicus. This steadily increased in size and opened spontaneously, evacuating about two pints of clear, yellow fluid. Since then the swelling had reappeared and had increased in size until, on admission, it was about the size of a peach. The father also said that the child had been incontinent, day and night, since birth.

Examination showed an undernourished child weighing 16½ pounds. He had a very large head, the throat was negative, the neck was stiff, the lungs were clear and the heart sounds were normal. There was a general lymphadenopathy and the legs were bowed. The abdomen, in addition to the scarring, was markedly protuberant. A swelling, 3 cm. in diameter, elevated 1 cm., was situated just below the umbilicus. This was tender and fluctuating with a sense of induration extending down to the symphysis pubis. There was dulness on percussion over a large area in the median line, below the umbilicus. Aspiration of the swelling revealed a clear fluid which contained 0.85 gram of urea per litre. Methylene blue was administered internally and appeared both in the urine, as voided, and also from the opening just beneath the umbilicus.

Cystoscopy showed a small orifice of a diverticulum in a markedly trabeculated bladder. A cystogram with 25 per cent solution of bismuth and ammonium citrate showed a small contracted bladder, above which was a large mass with an irregular border, extending from the symphysis to the umbilicus. I was also inclined to believe that there was a diverticulum in the posterior urethra. The catheter, when introduced, seemed to double on itself in the deep urethra (showed a cystogram of the bladder). The child also had a patent urachus, that communicated with his skin as the result of his being scalded.

Dr. Thomas F. Laurie, Syracuse, N. Y.: I would like to speak of two cases of pericystitis, one in a woman of thirty-five with a bad pelvic infection, with the abscess opening into the pelvis.

The other patient was a man of fifty who came in complaining of difficulty in urination. After he was catherized a suprapubic mass could still be felt. He could not be cystoscoped because of an old stricture. This was dilated and then we found a mass in the anterior part of the bladder, with pus flowing into the bladder. This was opened and drained and healed very kindly without trouble. He returned about three months later with the same condition. The abscess was opened again and drained and since then he has been perfectly well.

Dr. J. S. Read, Brooklyn, N. Y.: I want to speak of Dr. Chute's interesting cases. I saw one of these cases that developed in the lower space. The catheter could be passed easily, the perineal tube was inserted after the man showed signs of sepsis, but although the tube was left in and he was drained continually the sepsis continued until his death three weeks later.

In this case I secured an autopsy and it disclosed the condition spoken of by Dr. Chute. In addition, the bladder wall was thickened and filled with small punctate abscesses, and it was from this focus of infection that the man died. Had I had the information I secured from Dr. Chute's paper two years ago I am sure the result would have been different.

Dr. W. F. Martin, Battle Creek, Michigan: I wish to say a word in reference to Dr. Hyman's paper. I believe that his work on the fetus well demonstrates the etiology of diverticulosis of the bladder. I should like to record an experience which I have had. Five patients suffering from diverticulosis of the bladder were demonstrated, by means of the barium meal, to have multiple diverticulosis of the pelvic colon. I have noticed that in these cases of diverticulosis of the bladder there is usually some malformation elsewhere in the body, which can be demonstrated by careful study. This, I think, confirms the experience of Dr. Hyman demonstrating that diverticulosis is of congenital origin.

Dr. Arthur L. Chute, Boston (closing): Regarding the methods of infection in these cases, I agree with Dr. Quinby that in most instances the infection is introduced from a point in the urethra behind the sphincter.

Dr. Laurie has brought up another point regarding the way the infection is introduced. The cases I described here apparently came from traumatic infection but it seems perfectly possible that we may have the infection introduced into the perivesical tissues by the lymphatics.

One point in Dr. Hyman's paper: I called attention some years ago to the frequency with which one see little congenital pits about the ureter, usually below and to the inside. I have seen them ¼ inch deep. They must go pretty well through the muscular layer and offer a congenital anomaly that may serve as the starting point for these diverticula though their development probably depends upon some element of obstruction.

In regard to Dr. Koll's paper, I wish to report a fibroid of the bladder in a woman of about sixty, which I found on cystoscopy. It was a little growth, about the size of a lima bean. I could not be sure enough of its character to dare to ignore it so I opened the bladder and removed it; the patient did perfectly well. It apparently had nothing to do with her symptoms.

Dr. A. Hyman, New York (closing): I think one of the points in favor of the congenital origin is, that diverticula have been found in the fetus in a number of instances. On going through the German and French literature, I found at least a half-dozen case reports of diverticula in the fetus.

I want to emphasize that in none of our cases was any obstruction found in the urethra or bladder. In the case of the infant, I was particularly interested in this. On passing a catheter or bougie, no obstruction was encountered and with the bladder open, there was no sign of any stricture of the neck of the bladder to intravesical digital palpation. Two of these cases were treated for varying periods of time, for pyelitis. This is very important. A pyuria in a male child should be very carefully investigated, so as not to overlook a diverticulum or retention due to a stricture at the neck.

I was much interested in Dr. McCarthy's illustrations and just want to point out that the technique that Dr. Beer has advised for mobilizing the bladder differs in this respect, that after exposing the bladder, Dr. Beer grasps the urachus, clamps it and then cuts across. The end attached to the bladder with the clamp acts as a handle on which traction can be made, making mobilization of the bladder a much simpler procedure.

Dr. Joseph F. McCarthy, New York (closing): I think Dr. Quinby's point is well taken and for that reason I placed both procedures on the screen. Certain types of growth indicate the extra, while others, the transperitoneal approach, the latter applying especially to atypical growths presenting themselves on the anterior wall of the bladder and which may merely be the intravesical reflection of intraperitoneal malignancies.

I am afraid I have not made myself sufficiently clear to Dr. Hunner. My first pictures which were thrown on the screen applied to suprapubic cystotomy and in this procedure, I indicated the necessity of avoiding a separation of the cellular planes from the lateral aspect of the bladder, whereas in the latter pictures, the most complete mobilization of the bladder was necessary as resections were practised here.

If I had any doubts in the matter, Dr. Hunner has given indubitable proof that he does not perform prostatectomies on his cases.

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THERAPEUTIC VALUE OF TWO NEW SYNTHETIC ANTIMONY COMPOUNDS IN CASES OF GRANULOMA INGUINALE

ALEXANDER RANDALL

From the Wards of the Philadelphia General Hospital, Philadelphia, Pennsylvania

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Pursuant to the studies of the author in collaboration with James C. Small and William P. Belk in the past year (1) (2) on the occurrence of granuloma inguinale in the temperate areas of the United States (especially in the vicinity of Philadelphia), the interest aroused by its identification, its prevalence, its multiform manifestations, and characteristic bacteriology was not less than the remarkable therapeutic effect of tartar emetic in its cure.

Realizing the possible toxic effects and organo-irritative properties of tartar emetic, we watched our patients closely for evidence of intolerance, and fortunately were able to report nothing of a serious nature. Two patients gave evidences of renal irritation manifested by edema of eyelids and ankles, with albuminuria, which evidences cleared up completely on rest from the drug and in neither case reappeared on its more careful administration. Practically all patients who received injections of what we considered the maximum single dosage (0.10 gram) on alternate days, developed pains in the long bones and through the shoulder girdle—pains of rheumatoid character and generally wearing off in the course of the day on resuming ordinary occupational activities. There is no doubt that these pains were due to the administration of tartar emetic and were remarkably constant in their appearance. We did not experience any of the gastric or intestinal symptoms following the dosage used, though occasionally a patient would have some respiratory embarrassment associated with cough but no demonstrable cardiac depression. In one patient the constancy of this transient respiratory embarrassment, occurring just after the injection and lasting for a few hours, decidedly hindered our therapy. These evidences, though not alarming, made us constantly appreciate that we were dealing with a dangerous drug.

Feeling that possibly an antimonial compound of lesser toxicity and greater therapeutic action might be used, I wrote Prof. J. J. Abel (Pharmacological Department, Johns Hopkins University) on January 18, 1921, soliciting information and recalling to his mind his work of investigation on antimonial compounds in experimental trypanzomiasis. His reply received January 26, 1921, was so cordial and so characteristic of his broad scientific interest, that I quote his following remarks:

> The antimonials that were prepared by me some years ago have never been actually tested on human beings, although such tests are now being made in India and China. The tests, as far as I know, are being made upon Kala-Azar. . . . . Of course, you know that you will have to use tartar emetic with great care. You might write me again later after your test with tartar emetic, and if we can then spare you a small quantity of one of the preparations, I shall certainly be glad to do so.

After two months work on 9 patients suffering from granuloma inguinale carrying on the treatment with tartar emetic as advocated by Aragao and Vianni and getting the most encouraging results, I again wrote Dr. Abel on March 3, 1921, telling him of our success, and received a second letter from him on March 7, 1921, in which he said:

> Accept my thanks for writing me about your cases of tropical inguinal granuloma. Yes, I should like to have you try our antimonials and I am sending you a sample of each by this mail. One, sodium antimony thioglycollate, has been known to chemists for a long time. The triamide of antimony thioglycollic acid is a new synthetic composition, first prepared by myself. Both preparations were made about twelve years ago and have undergone only slight changes in this period, changes which will not effect their therapeutic efficacy. All you will have to do is to make up a solution, heat for a few minutes to sterilize and filter

off from it the small amount of antimony sulphid which has formed in the course of time and which amount has probably become augmented in the brief boiling. For intravenous injection another sterilization will be required after the filtration. As to the quantities to be used on human beings, you should ask one of your chemical friends to figure out how much will be required to give the same amount of antimony that is taken when tartar emetic is administered. I suppose that my compounds will be less toxic than tartar emetic. I should like especially to know how the triamide works out in your cases. What I am sending you of the triamide is the last in my possession.

A few weeks passed after receiving these drugs before a typical and uncomplicated case presented itself for trial. During this time I put the two drugs, sodium antimony thioglycollate and triamide of antimony thioglycollate (there being a single gram of each) in the hands of Frank E. Morgan and Sons along with Dr. Abel's (3) (4) reprints for the estimation of the antimony content, as he suggested, and received their report as follows: That in antimony and potassium tartrate, the antimony occurs as its oxide, standing in relation to the acid potassium tartrate as 40 parts to 50; that of these 40 parts, 75 per cent is antimony and 25 per cent oxygen; 75 per cent of the 40 parts or say 40 grams is 33⅓ per cent of the total 90, therefore 33⅓ per cent of tartar emetic is antimony. The new drug sodium antimony thioglycollate contains 30 per cent antimony and tartar emetic has 33⅓ per cent, so we concluded to administer the new drug in similar dosage to that already tried with tartar emetic, though feeling from Dr. Abel's statements, that it was decidedly less toxic.

The two drugs were prepared in 1 per cent solution and sealed under sterile precautions in ampules containing 10 cc. each.

On May 5, 1921 Edward P. presented himself at the Philadelphia General Hospital for treatment and gave in brief the following history:

Case 1. B. 5109. Adult negro, age thirty-two. Entered hospital complaining of sore on glans penis of four years' duration.

Past history. Was born in South Carolina; moved to Harrisburg, Pennsylvania, when thirteen years of age and has lived in Pennsylvania ever since and has not travelled outside the state. As a boy, worked in stores and since at construction work. Never married. Has had gonorrhea twice. "Chancre" and bubo twelve years ago. Has had pediculosis several times. General health has always been good, never sick in bed.

Present illness. Four years ago noted "a crack" in skin of foreskin at frenum. This slowly became sore and inflamed. At the end of one year there were two sores each about the size of a finger nail. Went to the hospital, where from 9 to 12 injections of neosalvarsan were given. The sores dried and were not bothersome, but did not completely heal. One month after the last injection, the sores again became irritated and surfaces oozing and increased in size. He states that the greatest growth has been in the past ten months.

Physical examination. Patient a well nourished negro male. Head: Eyes, ears, nose and mouth negative. Chest: Normal in contour. Lungs: Some difference in percussion note and vocal fremitus. Breath sounds harsh over both upper lobes anteriorly. No râles or areas of activity detected. Heart: No abnormalities. Abdomen: Negative. Extremities: Curved nails. Skin: Negative. Genitalia: Foreskin is swollen, edematous and almost covering the glans. On the glans about the meatus and on the reflected surface of the foreskin, out on each side from the frenum, are sharply defined, firm, slightly elevated lesions of raw, red, oozing surfaces, each about 2 by 1.5 cm. There is no ulceration at edges, no slough, no purulent exudate, no pain, no bubo.

May 6, 1921. (1) Laboratory reports smears positive for organisms of granuloma inguinale. (2) A piece of tissue taken from edge of growth for histological study. (3) Photograph taken of lesions. (4) Wassermann test reported positive—Luetic++; Cholesterin++; Noguchi+. (5) Urinalysis: Appearance yellow; sediment, none; reaction, acid; specific gravity, 1.026; sugar, negative; albumin, trace; leucocytes, 50 to 100; epithelium, numerous. (6) Blood count: hemoglobin, 100; red blood cells, 4,680,000; white blood cells, 5200; polymorphonuclears 60 per cent; lymphocytes 28 per cent; mononuclears, 7 per cent; transitionals, 5 per cent.

May 7, 1921. Cultures from lesion, negative for Friedlander-like bacillus. Smears positive for granuloma organisms.

May 9, 1921. Smears positive for granuloma organisms. Cultures negative for Friedlander-like bacillus. Blood culture sterile. Fragility test: Complete hemolysis 0.22; complete inhibition 0.36; complement fixations using antigens made from organisms cultured from two cases of granuloma in previous series and a Freidlander-like bacillus from sputum, all negative. Agglutination tests using suspensions of strains as above and incubated for eighteen hours at 50°—all negative in dilutions from 20 to 2500.

May 14, 1921. Inoculation of patient—two abraded areas were made on the left arm; one was inoculated with cotton swab with a twenty-four hour culture of the Friedlander-like bacillus isolated from typical case of previous series; the other with normal salt solution as a control. Patient kept off specific antimony treatment until May 31, 1921, and observations made up to this time showed negative results.

May 20, 1921. Histological study of tissue removed presents the characteristic picture of granuloma lesions with the young connective tissue proliferation, many endothelial leucocytes and a smaller number of polymorphonuclear neutrophilic leucocytes. There is very little proliferation of epithelium from skin edge as seen in other specimens. A few intracellular coccoid forms suggesting granuloma organisms minus their capsules are seen, and occur only in the large monouclear cells.

May 30, 1921. During interval of waiting and study, patient has been given three injections of neosalvarsan, each 0.9 gram. "Sores are somewhat drier and cleaner, but there is no epithelial proliferations at edges, no islands of new skin formation, i.e., no healing as seen in granulomas under tartar emetic treatment."

May 31, 1921. Given 0.05 gram of sodium antimony thioglycollate intravenously.

June 2, 1921. Given 0.06 gram of sodium antimony thioglycollate intravenously.

June 6, 1921. Given 0.07 gram of sodium antimony thioglycollate intravenously. Lesion is paler in color, drier, and epithelial proliferation has started along all edges. Patient has taken drug without any evident ill effect.

June 10, 1921. Given 0.10 gram of sodium antimony thioglycollate intravenously.

June 13, 1921. Given 0.10 gram of sodium antimony thioglycollate intravenously. Lesion healing rapidly.

June 16, 1921. Given 0.10 gram of sodium antimony thioglycollate intravenously.

June 24, 1921. Lesion healed, one area covered with superficial scab. Patient placed on tartar emetic treatment and given 0.10 gram today.

June 27, 1921. Given 0.10 gram tartar emetic intravenously and discharged to dispensary for continuation of treatment.

Comment. This case was included and reported in the published series (Randall, Small and Belk) of 16 cases of granuloma inguinale. Because of the small amount of this new drug at our disposal, I changed to tartar emetic administration as soon as complete healing had occurred, and the patient was given the usual 10 injections subsequent to healing that we have found necessary to establish a complete cure. There seemed to be no intolerance for the new drug, and at no time during its administration were any symptoms in evidence suggestive of its toxicity. The rheumatoid pains about the shoulder girdle and in the long bones, so characteristic of tartar emetic administration were noteworthy by their absence. Healing of the lesion of four years duration was accomplished in twenty-four days, and the administration of 6 doses.

The clinical picture is a little clouded by his history of syphilis and the positive Wassermann test. This complication existed in 5 of our last 19 cases, and in each a preliminary series of neosalvarsan injections were given to note the effect upon the lesion. In this case 3 injections caused no apparent change in the lesion, (as also the 9 to 12 injections given prior to our observation of the case), and the prompt result and healing following the adminstration of antimony left nothing to be asked.

The accompanying illustrations (fig. 1) shows the lesion before treatment.

Case 2. Stephenson G., colored, male, age thirty-four. Admitted to the hospital July, 28, 1921, complaining of sore on penis of fifteen years' duration, also headache, giddiness and double vision.

Past history and present illness. (This is of such unique interest, is given so explicitly, and illustrates so clearly the consistent error in diagnosing, that it is worthy of detailing.) In 1906 he developed "five little blisters" on the glans penis, these he "picked with a red hot needle," following which they "commenced to get raw." He was living in Haverstraw, New York, at that time, and subsequently moved to Philadelphia. He first consulted a private physician who prescribed local treatment and made the lesions worse. A second private physician was consulted whose efforts gave similar results. In 1909 he was treated at ——— Hospital, New York City, where a diagnosis of syphilis was made and injections of mercury given. A third private physician treated him with local applications for one year and the sores healed to the "size of a dime." He then enrolled at the W--- Hospital, Philadelphia, where 3 injections of salvarsan were given and a Wassermann taken, results of which are unknown, and then was treated at X--- Hospital, Philadelphia, given 9 injections of salvarsan and again results of Wassermann test unknown. In 1911, still uncured, he shipped for a cruise and visited Rio Janerio, where he was sick in a hospital for eight weeks and given 4 injections of "genuine German salvarsan." On returning to Philadelphia, he was treated at Y--- Hospital, receiving 3 injections of salvarsan, with a Wassermann test taken, the result of which is unknown. In 1912–1913 he was treated at the Z--- Hospital and his Wassermann when taken on admission was reported plus 5; after 7 injections (salvarsan) the Wassermann was reported plus 3; after 7 more injections the test was reported negative. He persisted under treatment and was given a third series of 7 injections and a second negative Wassermann. Two weeks rest and a fourth series of injections was followed by a Wassermann report that caused "dispute among the physicians." When asked the result upon the

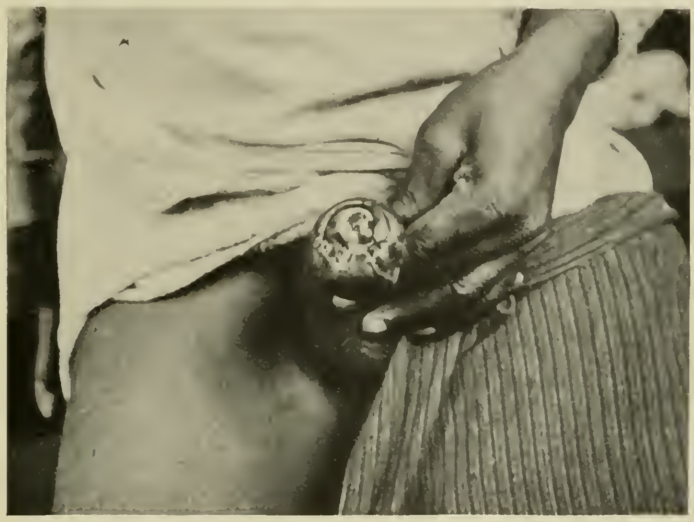
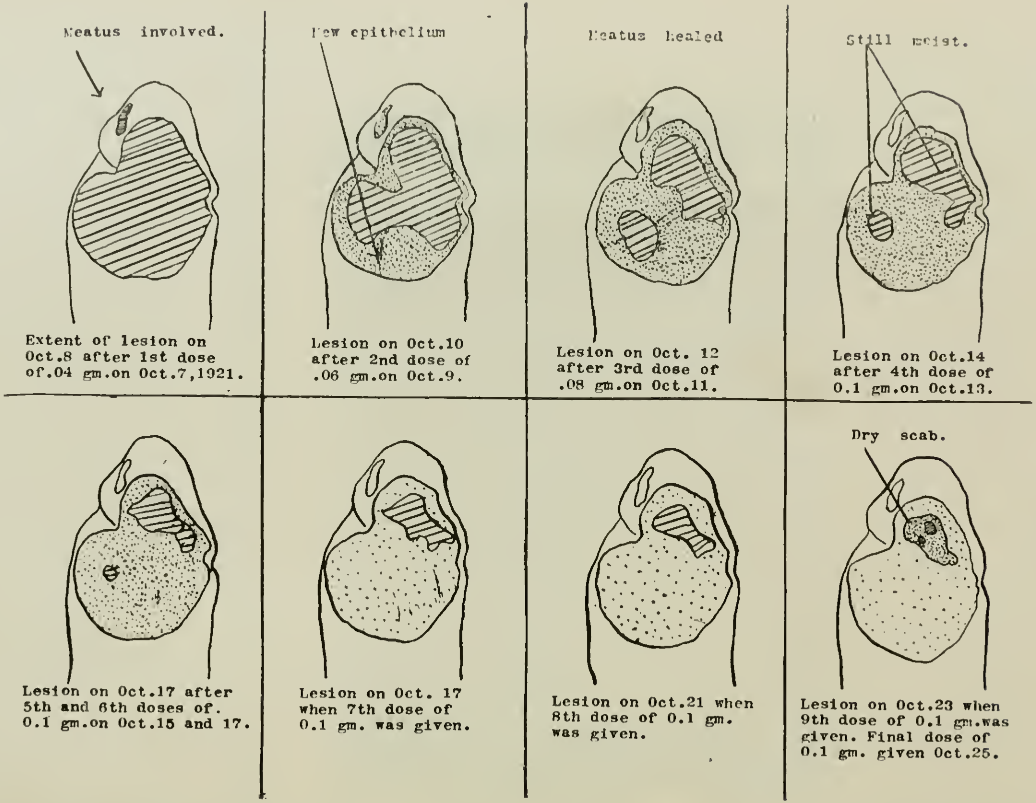


Fig. 1. Case 1

Photograph of four-year old lesion at start of treatment. Completely healed in twenty-four days with 6 doses of sodium antimony thioglycollate, totalling 0.48 gram of drug.



Extent of lesion on Oct.8 after 1st dose of.04 gm.on Oct.7,1921.

Lesion on Oct.10 after 2nd dose of .06 gm.on Oct.9.

Lesion on Oct. 12 after 3rd dose of .08 gm.on Oct.11.

Lesion on Oct.14 after 4th dose of 0.1 gm.on Oct.13.

Lesion on Oct.17 after 5th and 6th doses of. 0.1 gm.on Oct.15 and 17.

Lesion on Oct. 17 when 7th dose of 0.1 gm. was given.

Lesion on Oct.21 when 8th dose of 0.1 gm. was given.

Lesion on Oct.23 when 9th dose of 0.1 gm.was given. Final dose of 0.1 gm. given Oct.25.

FIG. 2. CASE 2

Bedside sketches of lesion undergoing treatment. Duration fifteen years; healed in seventeen days after 9 doses of triamide of antimony thioglycollate, totalling 0.78 gram of drug.

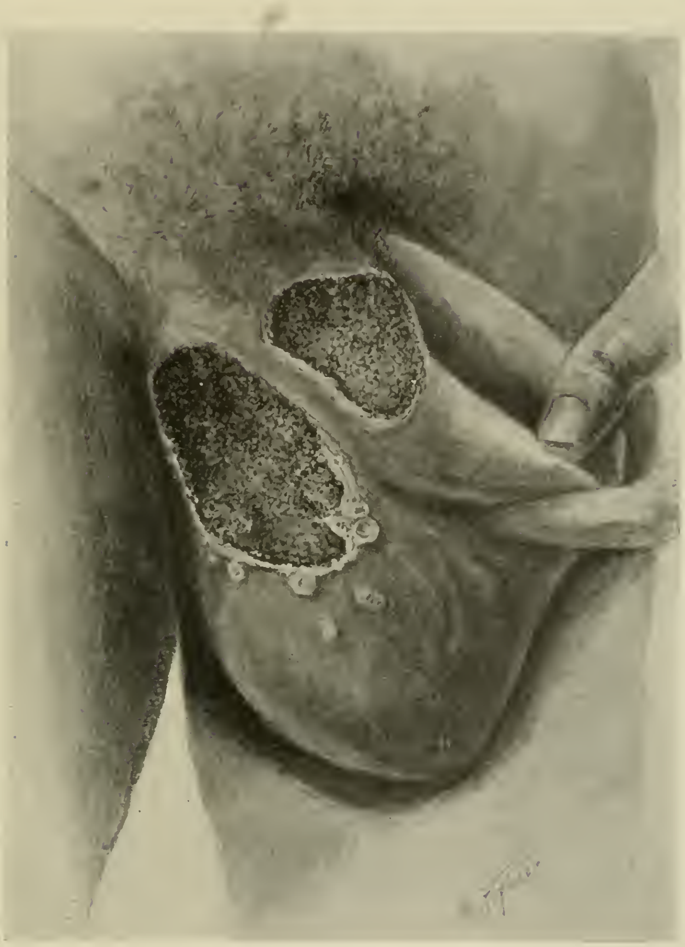


FIG. 3. CASE 3

Artist's drawing of typical granuloma lesion of two years duration. Given 3 injections of sodium antimony thioglycollate and 8 injections of tartar emetic in an interval of twenty-eight days, with complete healing. Recurrence three months later and again healed with 14 injections of triamide of antimony thioglycollate.

penile sore it appeared to have been unchanged, "same old thing." Another private physician, three further Philadelphia Hospitals and one in Baltimore failed to effect a cure and he came under our observation with a lesion of fifteen years' duration.

Status praesens. Three weeks ago he had an attack of vertigo followed by facial paralysis and double vision. There is found a raised, granulating lesion, devoid of ulceration and measuring 6 x 5 cm. on left lateral side of the glans penis and distal portion of the shaft of the penis, and a second lesion of smaller size about the meatus. His blood Wassermann is negative with all antigens, but his spinal Wassermann is plus 4, the cell count 107 per cubic millimeter and the colloidal gold curve was 4444432100. The lesion was considered a gumma. He received 9 injections of neosalvarsan (0.9 gram), active mixed treatment with mercury and iodides, and spinal drainage. At the end of August, 1921, his history laconically states "lesion on penis fails to heal." The last neosalvarsan was given on October 3, 1921. On September 20, 21 and 22, smears were found positive for the organisms of granuloma inguinale. His spinal fluid Wassermann on October 6, 1921 was still plus 4, cell count 4 per cubic millimeter, and colloidal gold curve 1122200000.

October 7, 1921. Patient given 0.04 gram of the triamide of antimony thioglycollate intravenously. There was no reaction except a slight headache, possibly attributed to recent spinal puncture.

October 8, 1921. Slight edema of eyelids noted, and urine showed faint trace of albumin (same noted on admission) and 10 to 20 hyaline casts.

October 9, 1921. Given 0.06 gram of drug intravenously.

October 10, 1921. No reaction, urine free of albumin, 10 to 15 hyaline casts seen. Edges of lesion show beginning epithelization.

October 11, 1921. Given 0.08 gram of drugs. Urine free of albumin, occasional hyaline casts. Slight edema of eyelids.

October 12, 1921. Active healing of lesion. No albumin, no casts in urine. Patient feels extremely well.

October 13, 1921. Given 0.10 gram of triamide of antimony thioglycollate.

October 15, 1921. Given 0.10 gram of triamide of antimony thioglycollate. Urine normal; slight edema of eyelids. Patient fells well.

October 17, 1921. Given 0.10 gram of triamide of antimony thioglycollate. Lesion rapidly healing.

October 19, 1921. Given 0.10 gram of drug. Few casts in urine; lesion all but healed.

October 21, 1921. Given 0.10 gram of drug.

October 23, 1921. Given 0.10 gram of drug. Lesion practically healed.

October, 25, 1921. Lesion entirely healed. Given final dose of 0.10 gram of antimony thioglycollate. Requests his discharge.

October 28, 1921. Given 0.10 gram of tartar emetic and discharged to dispensary to continue the same injection for 10 more doses.

Comment. This patient presented a typical granuloma lesion and though he likewise harbored a leutic infection, the latter appeared limited to the cerebrospinal system and his intensive preliminary antiluetic treatment though materially improving his spinal fluid tests had no effect whatsoever upon the superficial penile lesion. The effect of this new drug upon the penile sore is graphically depicted in the accompanying bedside sketches, while the promptness of healing leaves nothing to be desired after fifteen years duration. The entire amount of the drug at our disposal was used in this case and though it was over ten years old and required filtering to remove a slight precipitate of the sulphide of antimony (see final note) we could not discern that it possessed any toxic effects, in the dosage used.

This patient disappeared from observation following this short course of injections and did not take the subsequent injections of tartar emetic as advised. He was traced with difficulty and finally seen personally on May 13, 1922 (six and one-half months later), at which time he was found to be in good condition, had had no further treatment and his lesion remaining perfectly healed.

Case 3. William R., colored, male, age forty-nine. Admitted to the hospital on November 26, 1921, complaining of sores on scrotum. His past history reveals nothing of importance. He is single and denies any venereal disease.

Present illness. Lesion began over two years ago while working in a ship yard in Philadelphia. Starting as a small raised papule, it soon became raw and has gradually increased is size, without ever healing. The second lesion appeared "some months" after the first. There has been no pain or discomfort, only a local itching aggravated when warm and perspiring.

Physical examination. Head, chest and abdomen are negative, except for occasional reduplications of heart beat. Genitalia: Scrotum is large and pendulous. On the right side is a raw area measuring 10 x 6 cm. with raised edges and a clean surface of pure granulation tissue. There is no undermining, no ulceration, induration, sloughing, adenitis, or odor present. Just anterior to this lesion is a second one of one-half the former's size, and of exactly similar character. About the periphery of the larger lesion, and likewise in the groin, are several dermal nodules that undoubtedly are new proliferating lesions. The larger having already lost their epidermis and presenting a granulation tissue surface.

November 28, 1921. Blood Wassermann reported negative on all antigens. Smear positive for granuloma organisms. Urine analysis: trace of albumin, white blood cells, otherwise negative.

November 29, 1921. Cultures positive for granuloma organisms.

Treatment. December 12, 1921. Given 0.05 gram of sodium antimony thioglycollate. No reaction.

December 14, 1921. Given 0.06 gram of sodium antimony thioglycollate.

December 17, 1921. Given 0.10 gram of sodium antimony thioglycollate. There has been no reaction to the drug. Lesion looks drier and has lost its raw, red color. This being the last of the drug in our possession, patient was then put on full dose of tartar emetic (0.10 gram) and same administered on December 20, 22, 24, 27, 30. Likewise on January 3, 1922, January 5, and 9. Healing followed this treatment very rapidly and the lesion was completely covered with epithelium on January 10, 1922.

January 12, 1922. Lesion healed. Patient has developed a bronchitis and antimony treatment omitted.

January 23, 1922. General condition excellent. Given tartar emetic 0.05 gram. Same repeated January 25 and 27.

January 31, 1922. Patient requests his discharge. Lesion healed. Given tartar emetic 0.10 gram intravenously, and ordered to return to out patient department for 10 weekly injections.

Comment. Uncomplicated lesion of two years duration completely healed with 3 injections of sodium antimony thioglycollate (totalling 0.21 gram) and eight injections of tartar emetic (totalling 0.80 gram) in an interval of twenty-eight days. This patient had symptoms of intolerance to tartar emetic, especially the bone pains and transient bronchitic cough; symptoms that were not seen while taking the sodium antimony thioglycollate.

This case is of particular interest because of a recurrence three months later. He got arrested during a street brawl the day of his discharge and was placed in gaol, and did not get the 10 injections following the complete healing of the lesion that we have always considered necessary. Released from gaol April 1, 1922, he noticed a recurrence of his granuloma on April 6, and was admitted to the hospital on April 8 desperately ill with lobar pneumonia. His recovery was prompt, and on April 25 he was transferred to the genito-urinary service, with active proliferating areas of recurrent granulomas about the entire periphery of the old lesions, having had no treatment for the same while in the medical ward.

This patient was healed a second time with 14 injections of the triamide of antimony thioglycollate (totalling 1.2 gram), a new synthetic preparation (see final note).

RÉSUMÉ

The purpose of this study and report is twofold: First, to test the toxicity of these two new synthetic antimony compounds; and secondly, to establish their therapeutic value. It was greatly to be regretted that only 1 gram of each was available. The sodium salt had been used before in man, Dr. Abel having sent a quantity of it to Asia for use in cases of Kala-Azar, though its therapeutic value has not yet been reported upon. The triamide of antimony thioglycollate was used for the first time in man in case 2 with the brilliant therapeutic result above reported. In the dosage used no toxic effects were noted and there was a complete absence of the symptoms we have been accustomed to see following tartar emetic administration, evidencing intolerance to the drug.

FINAL NOTE

Feeling that in the triamide of antimony thioglycollate there existed a drug of therapeutic value practically specific in its action on the lesions of granuloma inguinale, and of toxicity probably less than that of tartar emetic, a drug that when given intravenously exercised a bacteriocidal action in this superficial skin lesion similar to the spirochaetacidal action of salvarsan, and a drug that may possess value where similar ends are sought in therapy, it was decided to place its formula in the hands of competent pharmacists for greater production. Through the interest and skill of Hynson, Wescott and Dunning, a similar triamide salt has now been prepared in a more perfect crystaline form (and devoid of the sulphide precipitation), as likewise the sodium salt, and both are at present undergoing therapeutic valuation in this disease, a subsequent report of which shall be made.

REFERENCES

(1) Jour. Urol., 1921, v, no. 6, p. 539.
(2) Surg., Gyn. and Obst., June, 1922, xxxiv, no. 6, p. 717.
(3) Jour. Pharm. and Exper. Therap., October, 1910, ii, no. 2, p. 101.
(4) Jour. Pharm. and Exper. Therap., July, 1911, ii, no. 6, p. 501.

GRANULOMA INGUINALE (ULCERATING GRANULOMA, SERPIGINOUS ULCERATION OF THE GENITALS, ULCERATING GRANULOMA OF THE PUDENDA, ETC.)

MILTON WEINBERG
Sumter, South Carolina

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This disease was first described by Conyers and Daniels in 1896 in negroes in British Guiana. A little later Macleod, Maitland, and other writers made observations in India. In this country, in 1913, Grindon first described the disease in his report of 3 cases having features similar to it. He was unable to demonstrate either of the organisms, Donovan bodies or spirochetes, usually found in the lesions.

In May, 1920, Symmers and Frost reported 2 cases which they had only a short time previous to publication seen in Bellevue Hospital, New York City. They believed the lesions indigenous to the United States. The organism, which was first described by Donovan in 1905, was found in the lesions of both patients. The patients were successfully treated with intravenous injections of a tartar emetic solution, thus showing the specific action of this drug upon the disease, as was shown in 1912 by Aragao and Vianna, of Rio Janeiro. Up to 1912, treatment was very unsatisfactory.

Granuloma inguinale occurs in tropical, sub-tropical, and temperate latitudes. Until recently, it was thought to be confined to the tropics, especially prevalent in British Guiana, West Africa, and certain parts of South America. It was also known not to exist in many other parts of the tropics.

Following the report of Symmers and Frost, many other cases have been recognized in the United States, especially the eastern section, both North and South, sufficient to show that the disease exists endemically in this country. I have recently found 3 cases which I believe to be indigenous to South Carolina. Lynch first reported cases in this state. These were seen at the Roper Hospital, Charleston, South Carolina. Since his report, I have learned through personal communication that many cases have been and are now being found there; also, that some cases have been found and successfully treated in Williamsburg County in this state.

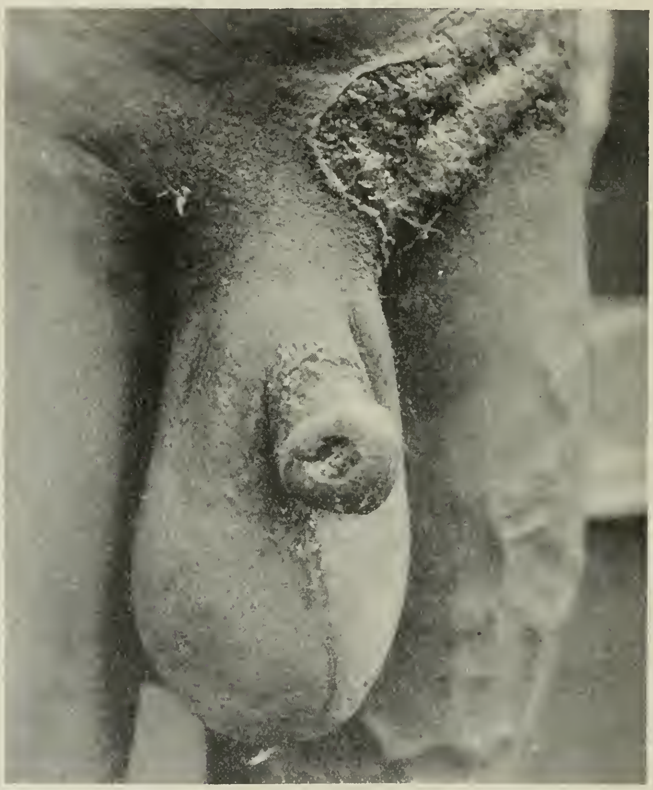

Fig. 1. (Case 2)

Randall, Small, and Belk have observed 16 cases in the Philadelphia General Hospital and believe, from what they consider reliable information, that the disease has existed in Philadelphia for the past fifty years, and has been wrongly diagnosed. A number of cases have been seen in the Urological Clinic of the Johns Hopkins Hospital. Goodman has shown that it is not infrequent in New York City. Cases have been found in Richmond, New Orleans, and other places.

Very many of the patients with this infection were born in the United States and have never been out of its continental territory. All of my patients were born in South Carolina, in or near Sumter, and 2 of them had never been out of the state; the other one was out of the state only for a short visit, once to Detroit, and once to Raleigh, North Carolina, and then at times which would make it appear certain that the infection could not have been contracted at either place.

Granuloma inguinale is a chronic disease affecting the skin or mucous membrane, or both. The general health, per se, is not usually affected. However, there is frequently found coexisting disease with marked impairment of the general health. The disease is very chronic, and certainly allows an opportunity for secondary general disturbances.

The usual sites of the lesion are the groin, genitalia, perineum, the vagina, anus, thigh, and buttocks. Rarely, it occurs upon the lips and other parts of the body. In the male it most frequently begins in the groin or on the penis, and in the female on the labia. In one of my patients it began on the prepuce, according to the patient's statement.

It is most frequently found in negroes, but is sometimes seen in the white race. It occurs after puberty, and among both males and females practically in the same proportion.

The mode of transmission is unknown. Some think that there is a venereal origin. This view is probably held because the common venereal diseases frequently (but by no means always) coexist. Against this idea, it is not uncommon to find a married man or woman with the disease and his or her partner not infected. It is also unusual to find both husband and wife infected. Goodman entertains the possibility of an intermediate host, as found in certain types of protozoa. Whether or not the Donovan organism, so frequently obtained from the lesions, is a protozoön is still unsettled.

The lesion begins as a papule commonly in the groin, or on the penis, or vulva. It may begin in other locations as previously stated. It becomes raw and reddened and breaks down into a superficial ulceration, spreading both by autoinoculation and direct extension. The skin and subcutaneous tissues become involved. The appearance of soft, healthy granulation tissue is assumed. New granulomata form at the margin, and the outline becomes irregular, but well defined. The granulating surface gives off a serous exudate and bleeds easily. The edges of this lesion are raised several millimeters or more and are somewhat hardened. There is often a tendency to healing, though complete spontaneous healing rarely occurs. Two of the patients stated that at several times the lesions became smaller, appearing as if healing was taking place. Hard fibrous tissue can be felt below the lesion. The lesions are very chronic, spread slowly, but are very destructive of the tissue involved. One of my patients shows almost complete destruction of the penis. There may or may not be a very offensive odor. An offensive odor is perhaps due to secondary invasion by some other organism. The lymph glands do not become enlarged, nor do they suppurate. There is, however, in some cases a lymphatic stasis with chronic edema of scrotum, penis or vulva.

The raw area has the appearance of the normal soft granulation tissue. A characteristic appearance of a healing lesion is a smooth, slightly glistening surface, appearing somewhat like a mucous membrane. The color may appear as if burned with carbolic acid and there may be pitting of parts of the healed process. Some of the healed portion may be covered with dirty looking scab.

It is still uncertain what organism causes the lesion. For some years, certain observers held the view that the causative organism was probably a spirochete. Spirochetes, some resembling the spirochaeta pallida and others the refringens, are observed in some of the lesions. One of my cases showed similar organisms. These were demonstrated in great numbers from a direct smear, stained with Hasting's stain, and obtained from the surface, after it had been cleansed, with a cotton swab.

In 1905, Donovan described an encapsulated organism (Calymmatobacterium granulomatis) which is frequently found in the lesion. It cannot always be demonstrated there. That this organism is the cause of the disease is still unsettled. However, the presence of this encapsulated body is taken as conclusive evidence for the diagnosis of the disease. If present, it can usually be obtained by a direct smear, and demonstrated with Hasting's, Wright's or Giemsa's stain. I have found Hasting's the most satisfactory. The smear is made very thin and is allowed to dry in the air. It is covered with Hasting's stain for about fifteen seconds, and is not fixed by heat. The smear is usually sparse in other bacteria, such as streptococci, staphylococci, etc. In 1 of the cases, pus cells were not numerous and

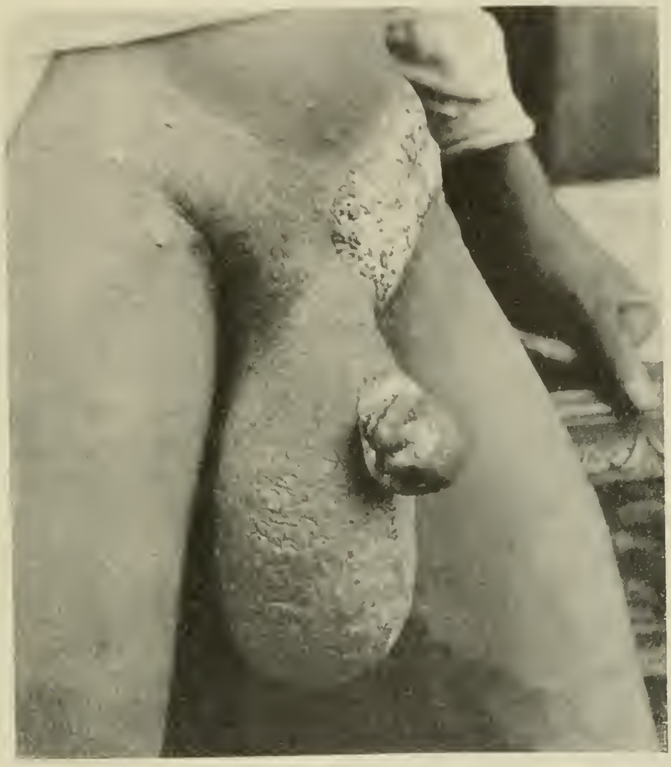

Fig. 2. (Case 2)

there was a fairly good number of large mononuclear cells. In the other 2 cases, pus cells were quite numerous, perhaps due to some secondary infection.

With Hasting's stain, the Donovan bodies appeared as round or oval bodies containing in its central portion of the capsule a short slender bacillus, some appearing like diplococci, others like cocci, and some showing bi-polar staining. They appeared to lie in the longitudinal axis of the capsule. The edge of the capsule was definitely outlined, showing a slight purplish tint, the capsule itself somewhat fainter in color, and the germ in its center taking the stain more deeply than any portion of the capsule. These bodies appeared in groups or nests inside the cytoplasm of the large mononuclear cell. Others appeared singly, or in groups outside of the cell. The pus cells did not seem to show the encapsulated type of the organism, but did show the bacilli, cocci, and diplococci as in the others. These may be immature forms of the mature encapsulated type. Wright's stain shows a pinkish color in the capsule. The organism could not be obtained after the fifth dose of tartar emetic in 1 of my cases. It appeared that the encapsulated form disappeared after each injection more rapidly than the other or non-encapsulated. In the patient that showed the spirochetes, there were no Donovan bodies found.

Attempts to reproduce the disease on both man and animals have so far been unsuccessful.

By cultures, organisms similar in many respects to the Friedlander bacillus, have been grown. Thus far, there is no certainty that the organism thus obtained is the same as that of the Donovan bacillus, as seen in the large mononuclear cells.

According to Goodman,

> Histopathologic studies of cases seen in the tropics or in New York City have disclosed no specific change, but the elongated papillae and interpapillary processes have been present, as would be expected from the clinical appearance of the lesion, with collections of fibroblasts, polymorphonuclear leukocytes, and round cells. There is nothing present to indicate the presence of epithelioma, tuberculosis or syphilis. It would as a general thing be impossible to make a diagnosis from the appearance of the section alone, although it might be suggested.

The subjective symptoms are not marked. There is nothing characteristic of the disease in the general examination or blood examination. The Wassermann test is negative, but many of the patients show coexisting syphilitic infection, in which case it is usually positive as ordinarily expected.

Diagnosis may be established by finding the Donovan bodies. The clinical appearance of the lesion often makes the diagnosis easy. However, there are protean types of this disease. Goodman states, "There is no fixed clinical type of granuloma inguinale." The therapeutic test with intravenous injections of tartar emetic may be very helpful in arriving at a diagnosis. The literature contains references, however, that tartar emetic also has a beneficial effect on other conditions, namely, kala-azar, bilharziasis, blastomycosis, trypanosomiasis, filariasis, and some tropical ulcers of unknown cause. A chronic granuloma, or granulating ulcer on or near the pudenda or groin, should make one suspicious of granuloma inguinale, and more especially in those cases that have previously resisted all other forms of treatment, principally salvarsan. While in most cases of granuloma inguinale healing may be seen to take place after 3 or 4 injections of tartar emetic solution, yet there are some cases that require very many more injections before any improvement may be noticed. In 1 of my cases 8 injections were given before there was any noticeable improvement. Lynch reports a case in which one of multiple lesions failed to improve until the sixth week of treatment while the other lesions in the same case readily responded.

The disease is most frequently confused with syphilis, but it must also be differentiated from chancroid, tuberculosis of the skin, epithelioma and yaws. Cases have been reported in which both lesions of granuloma inguinale and syphilis were situated very near to each other. Salvarsan therapy healed the luetic sore, but had no effect on the granuloma inguinale.

The prognosis is excellent. The lesions heal entirely under appropriate treatment. The prognosis, however, in the presence of coexisting disease will depend upon the merits of the other disease.

Tartar emetic is a specific in the treatment of granuloma inguinale. In many instances, healing may be noted forty-eight hours after treatment is begun. The drug should be given intravenously. It may be conveniently prepared for administration by making up a 1 per cent solution, dissolving chemically pure tartar emetic in cold sterile distilled water. The drug is readily soluble. I do not believe that it is necessary to sterilize further, as I have had no bad effects from it prepared in this manner. Some autoclave it, but there may be danger of breaking down the drug by heat.

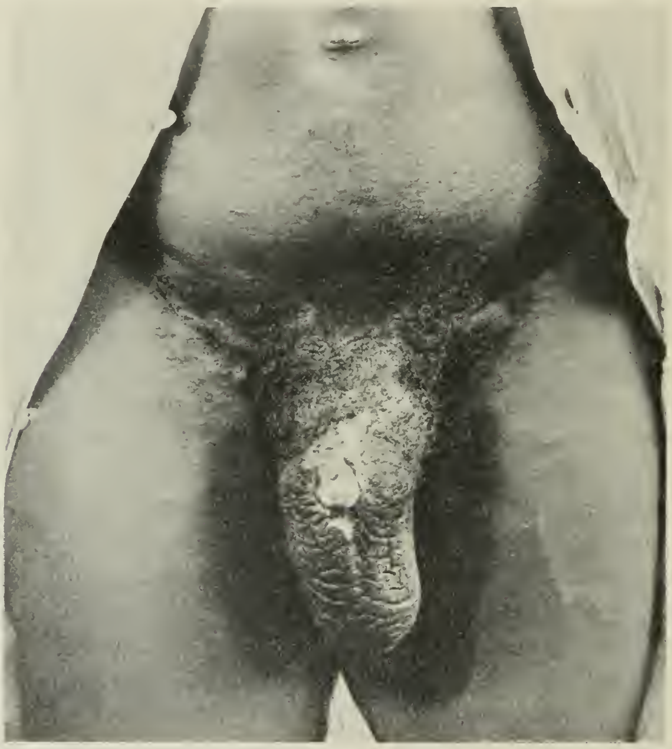

Fig. 3. (Case 3)

The patient is treated by beginning with 2 cc. of the 1 per cent solution and increasing the amount 1 cc. each day, giving every day, until toxic effect is noted. This usually requires about 6 to 10 doses. The maximum amount which can then be given without producing marked toxic symptoms, may be given every other day, or at intervals best suited to the patient's general reaction. The average case requires from 15 to 25 doses for complete healing. Treatment should be kept up at weekly or semi-weekly intervals for many weeks after the lesion has healed to prevent recurrences.

Toxic symptoms are usually soreness all over the body and severe cramps in the muscles. Some complain of nausea, stiffness and pain in the back of the neck and shoulder. There is nothing alarming about this. No bad effects have been seen from proper use of tartar emetic.

Local treatment for granuloma inguinale is not necessary. It seems that the lesions heal quicker when they are not bandaged, and when they are exposed to the air. Dressings, especially those that stick and cause bleeding when taken off, should be avoided. Perforated oil paper may be placed over the sore, if necessary, to prevent irritation from clothes.

Coexisting disease should be appropriately treated, and at the same time, if possible. If syphilis is present, the tartar emetic may be given in the intervals between salvarsan therapy.

In conclusion, I wish to express my gratitude to Dr. W. H. Burgess, Sumter, South Carolina, for referring to me the first patient and for his assistance in the management of the case.

REPORT OF CASES

Case. 1. Negro woman, twenty-eight, prostitute. Born near Camden, South Carolina. Has never been out of the State. Lived in Sumter since childhood. Last trip taken was to Charleston, South Carolina, in 1919. Complained of soreness about the genitalia.

Present local condition first noticed November, 1921.

Examination made February 9, 1922: Patient very poorly nourished. A large, raw, foul smelling, ulcerating lesion of the vulva, involving the labia minora and extending into the upper cleft of the vulva was seen. At that time, it involved only the upper half of the right labium majus, along with the labia minora. Specimen of blood showed four plus Wassermann reaction. She was given Hunter's specific for a few weeks.

The disease got no better. She was then given 11 doses of neosalvarsan, and intramuscular injections of mercury salicylate. Following this there was at no time any improvement in her general or local condition. She was again seen about four or five months after the antisyphilitic treatment and was found to be in a pitiful and helpless condition. The local lesion had extended until it involved the entire right labium majus, a good part of the left and into the vagina. There was one area of the lesion, situated like an island, which showed tendency toward healing. The appearance of this area was characteristic. It was covered over with a membrane, looking like a mucous membrane showing points of depression. In a direct smear from the lesion, the Donovan bacillus was found, and treatment begun for granuloma inguinale. A change could

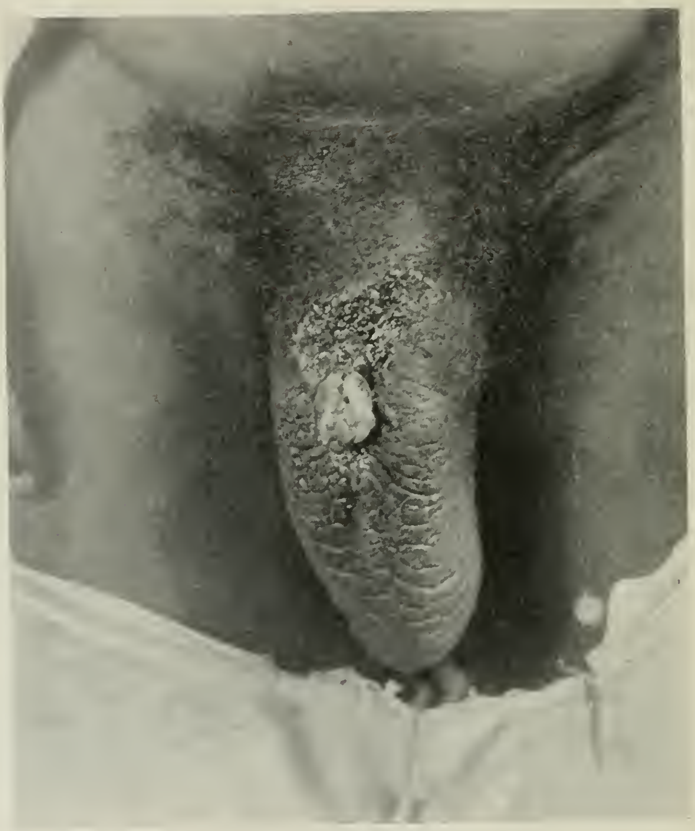

FIG. 4. (CASE 3)

be noted locally after forty-eight hours. After 15 intravenous injections of 1 per cent tartar emetic solution, totaling 75 cc., and with no other treatment, the lesion has completely healed and general condition very much improved.

Case 2. (fig. 1) Negro man, forty, widower, brick mason. Complaint, syphilis. Patient was born near Sumter and has never been out of the State. Has lived in Sumter since childhood. Normal weight 165 pounds, present weight 137 pounds. Poorly nourished, anxious looking. Present trouble began four years ago with "pimple" in left groin. Was about the size of pea. No pus. Soon became raw and bled easily. Nine days after first "pimple" another one about 2 inches apart began and acted in same manner. Sore on penis began about same time as others. Spreading took place from those lesions. Had pains in muscles of arms, legs and body. Weight of body when lying down caused marked pain throughout. Was in bed seven months almost from the beginning. Pains were worse at night. Took "shot of 606" which helped him to get out of bed.

Figure 1 shows extent of lesion very nicely. Wassermann negative. Donovan bodies numerous with Hasting's stain. Nothing further of special interest in general examination, except elephantiasis of scrotum.

Figure 2 shows almost complete healing twenty-seven days later, after 18 doses of tartar emetic intraveneously, totaling 104 cc. Slight decrease in size of scrotum. Patient seen again September 18, 1922; marked decrease in size of scrotum.

Case 3. (fig. 3) Negro man, twenty-five, single, mechanic, seen August 2, 1922. Complaint syphilis. Born near Sumter and has lived in this locality since birth. Has never been out of the United States. Out of this State only twice for very short visits, once to Raleigh, North Carolina, and once to Detroit.

Present condition began 1917. "It began as a little sore about the size of the head of a collar button on and underneath the foreskin. It looked like proud flesh that was going to spread, there was no bleeding but itching. It spread so much that foreskin could not be retracted. Was circumcised in 1917 for this trouble and it was ninety days before I could go to work on account of the soreness. Whole thing healed up to the size of a nickel. Healing part looked like slick skin, sometimes white and sometimes red. Went into the army in 1917. Specimen for Wassermann was two plus. Took 5 doses of 606 and 1 dose of mercury in hip. Sore did not heal. Have taken no other treatment except iodide of potash several times, which seemed to help it a little."

Examination. Patient well nourished. Wassermann, negative. No Donovan bodies found, but very many spirochaetae, some like the pallida, and others like the refringens with Hasting's stain from direct smear, and after surface had been cleansed off. The odor of the lesion was very offensive.

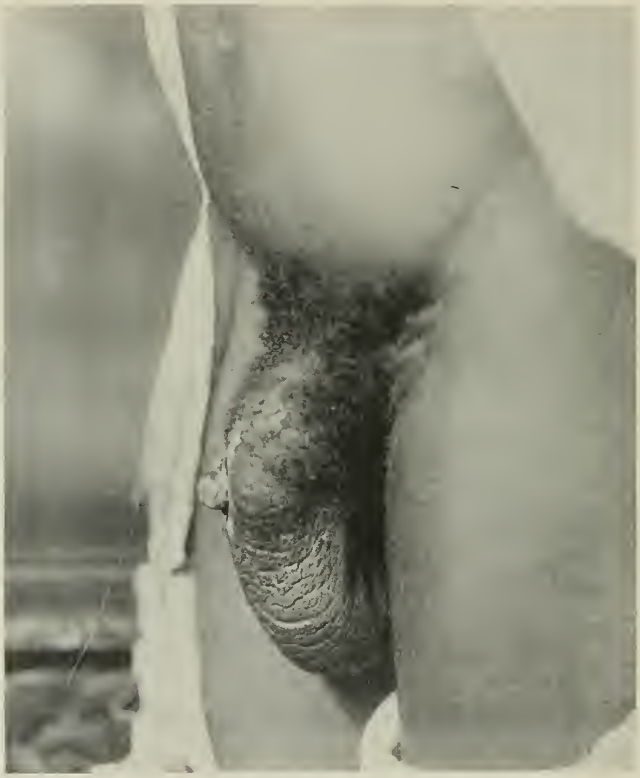

Fig. 5. (Case 3)

Figure 3 is a photograph of the lesion taken August 2, 1922. Figure 4 is picture taken August 29, 1922, after 15 injections of 1 per cent tartar emetic solution intravenously, totaling 85 cc. The lesion has entirely healed. Figure 5 is a profile taken same day as figure 4.

CONCLUSIONS

1. Granuloma inguinale commonly occurs in parts of the United States.
2. It is most frequently found in negroes, both male and female, but also occurs in the white race.
3. The mode of transmission is still unknown.
4. The organism that causes the disease is yet undetermined.
5. The diagnosis cannot be made from the histopathological examination, though it may be suggested.
6. A positive diagnosis may be made by finding the Donovan bodies. The presence of these bodies, however, is not constant, or they cannot be demonstrated in all cases. The clinical appearance of the lesions is often characteristic, yet there are protean types. The yielding of the lesions to tartar emetic therapy is indicative of the presence of granuloma inguinale, in certain types of granulomas.
7. Characteristic lesions have not yet been reproduced experimentally either in man or animals.
8. Cultivation of the organism on artificial media has not yet produced one that is identical with those seen in the large mononuclear cells.

REFERENCES

(1) Campbell, Meredith F.: Granuloma inguinale. Jour. Amer. Med. Assoc., March 5, 1921, lxxvi, no. 10, 648.
(2) Daniels, C. W.: Ulcerating granuloma of the pudenda. Allbutt and Rolleston, System of Medicine, ii, pt. 2, 708.
(3) Goodman, Herman: Ulcerating granuloma (granuloma inguinale). Jour. Amer. Med. Assoc., September 2, 1922, lxxix, no. 10, 815.
(4) Lynch, Kenneth M.: Granuloma inguinale (granuloma venereum; granuloma of pudenda; ulcerative vulvitis; etc.). Jour. Amer. Med. Assoc., September 17, 1921, lxxvii, no. 12, 925.
(5) Lynch, Kenneth M.: Tartar emetic in the treatment of granuloma inguinale and other granulomata and granulating ulcers. Sou. Med. Jour., September, 1922, xv, no. 9.
(6) Parounagian, Mihran B., and Goodman, Herman: Ulcerating granuloma (granuloma inguinale). Archives of Dermatology and Syphilology, May, 1922, v, no. 5.
(7) Randall, Alexander, Small, James C. and Belk, William P.: Granuloma inguinale. Surg., Gynec. and Obstet., June, 1922, xxiv, no. 6, 717.
(8) Symmers, Douglas, and Frost, Albert D.: Granuloma inguinale in the United States. Jour. Amer. Med. Assoc., May 8, 1920, lxxiv, no. 19, 1304.

TORSION OF THE SPERMATIC CORD[1]

EDWARD L. KEYES, Jr., CLYDE W. COLLINGS, and
MEREDITH F. CAMPBELL

From the Department of Urology, Bellevue Hospital, New York

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INTRODUCTION

Torsion of the spermatic cord, usually called torsion of the testicle, is a condition caused by a twisting of the cord suddenly shutting off the blood supply of the testicle and epididymis.

Acute torsion is characterized by the sudden onset of a severe, stinging pain in the involved testicle, with early swelling and local signs of inflammation within the scrotum, together with a generalized systemic reaction—nausea, vomiting, chills, fever, and abdominal pains.

Chronic or relapsing torsion simulates acute exacerbation of a chronic epididymitis; the condition rights itself early, usually within twenty-four hours, when the cord becomes untwisted, in fact Van der Poel's (1) patient learned to unwind his own cord.

The etiology is still obscure; treatment is chiefly surgical.

INCIDENCE

The lesion is probably not as uncommon as the rarity of the recorded cases would suggest, there being less than 100 cases reported since the condition was first recognized in 1840. We have collected 7 cases which we present in conjunction with certain experimental observations.

Four of our patients were studied in the urological wards and 2 in the surgical wards of Bellevue Hospital. One case we are able to include through the kindness of Dr. A. R. Stevens.

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[1] Read at the meeting of the American Urological Association, Atlantic City, April, 1922.

ETIOLOGY

The predisposing cause of torsion is an undue mobility of the testicle and this is commonly associated with incomplete descent of this organ into the scrotum at least to the extent of an unusual length of gubernaculum. Imperfect descent of the testicle has been noted in nearly 50 per cent of the recorded cases of torsion. Our 4 personally operated cases showed a gubernaculum unduly long and lax (2 cases) or wholly absent (2 cases). It is our impression that the long and lax gubernaculum would be almost always, if not invariably, found, when looked for.

The exciting cause of torsion may be unknown. Three cases, for example, have been recorded (2) as occurring during sleep. But violent muscular effort, such as the strain of lifting, jumping, playing basket ball, seemed to be the immediate exciting cause in 5 of our cases, while 1 resulted from a direct squeeze. Thus muscular strain either of the abdominal muscles or of the cremaster on the loosely attached scrotal testicle is doubtless the predominating exciting cause of torsion.

The age at which torsion occurs supports this contention. The ages of our patients were twenty-three, twenty-five, sixteen, sixteen, fifteen, fifteen, and twenty-three; and 75 per cent of the recorded cases have occurred before the age of twenty.

SYMPTOMS

Patients with acute torsion usually state that immediately after lifting or straining, rather sharp stinging pain was noted in the testicle. The pain may not be severe at first; in fact 2 of our patients kept on at work until evening. Within twenty-four hours the scrotum is several times the usual size, red, edematous and exquisitely tender. Severe pains are referred up the spermatic cord and systemic symptoms such as nausea, sweats, and prostration may be present, and are sometimes very severe. In 4 of our cases, without complications, the maximum temperature before operation was 99.4°. Some observers have attested that the severity of the symptoms varies directly with the tightness of the twist. Cases of torsion without tenderness or pain have been reported (3).

If the patient stays in bed and has an adequate suspensory applied, together with an ice bag, he is usually comfortable and free from pain. With the occurrence of gangrene the pain becomes less and may even disappear. In relapsing torsion the testicular pain lasts for a few hours only; after the cord has become untwisted the patient is free from pain until the next attack.

DIAGNOSIS

The diagnosis of torsion of the testicle may readily be made by one who thinks of it. Thus two physicians who had seen some of our cases of torsion in the hospital have informed us that within the past few months they have each seen 2 cases of torsion in their own practice. It is this fact that leads us to suspect that torsion is much more common than is generally believed, but is not infrequently overlooked.

The diagnosis of torsion must be thought of in all cases simulating acute infection or trauma to the testicle in the scrotum, or in the inguinal canal; and in the latter position the diagnosis of strangulated hernia should not be made without considering the possibility of torsion of the spermatic cord.

Moreover, the cases which one sees from time to time of partial or complete atrophy of the testicle which are attributed to "sitting on a cold stone," or some equally frivolous cause, are very possibly evidences of atrophy following upon torsion which has been overlooked.

In the actual diagnosis of torsion the age of the patient (above puberty and below twenty-five), the misplacement of the testicle, or at least the looseness of the gubernaculum (which may be bilateral—the other testicle should always be examined), and the lack of involvement of spermatic cord above the testicle, and of prostate and seminal vesicles are elements that strongly favor torsion.

The history of trauma varies, but definite trauma was alleged in 5 of our 7 cases, and the history was obscure on this point in 2 others.

The presence of a complicating urethral gonorrhea obscured the diagnosis somewhat in 1 of our cases.

Antecedent testicular mobility was admitted by 3 of our patients, 1 of them remembering that when riding a mule his testicle had risen to the region of the external ring.

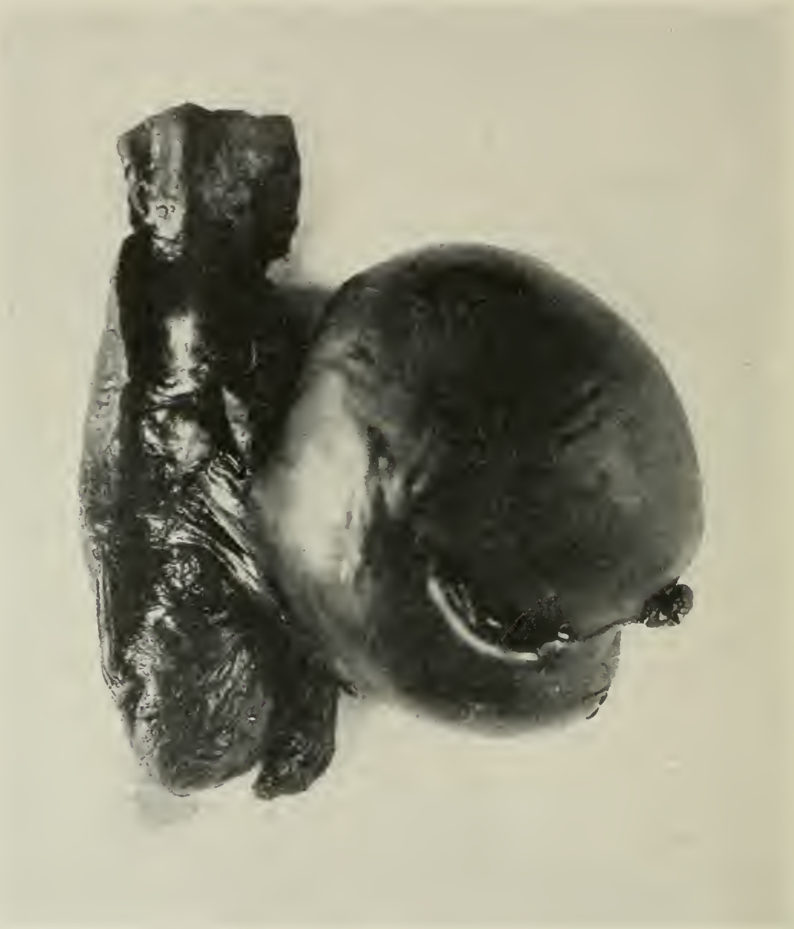

FIG. 1. J. G., TORSION OF THE SPERMATIC CORD, THE TWIST OCCURRING JUST ABOVE THE UPPER POLE OF THE TESTICLE AND SPIDIDYMIS

Orchidectomy eight days after onset of pain in testicle

Careful consideration of the history and palpation of the involved testicle will readily make the diagnosis. Examination shows an enlarged, tense testicle which at first may be exquisitely sensitive but later becomes quite insensitive, and in which the epididymis, the tunica vaginalis, the testicle cannot be differentiated, while the peritesticular edema of the scrotum is never as great as in a similar involvement of gonorrheal origin. The temperature is little elevated by torsion, in contrast to the high temperature of epididymitis. The process stops immediately above the testicle, the elements of the spermatic cord feeling entirely normal.

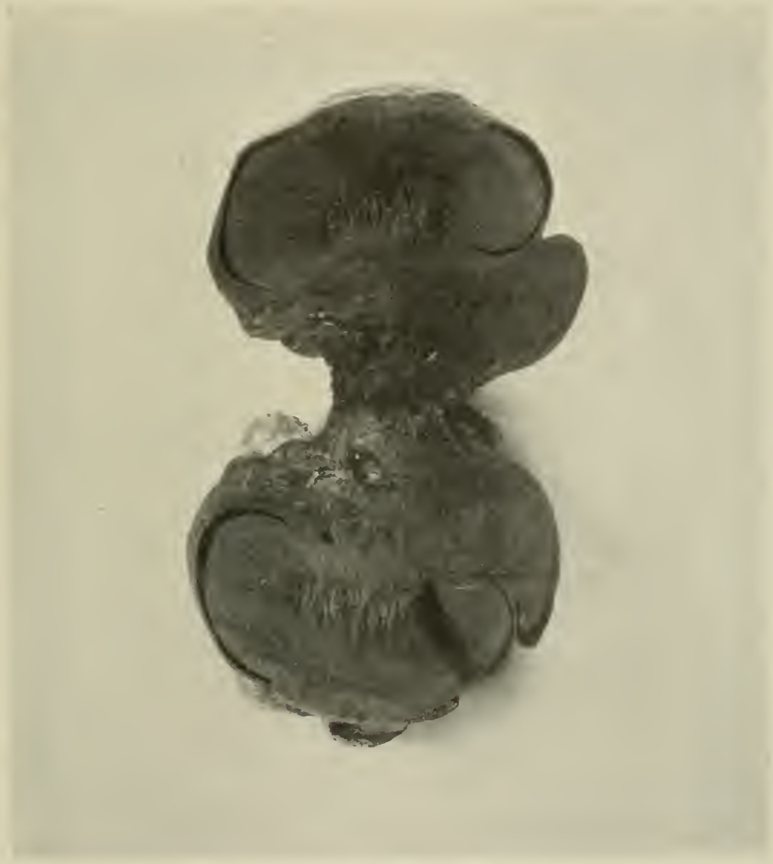

FIG. 2. J. G., CUT SURFACE OF TESTICLE AND EPIDIDYMIS SHOWING GANGRENE AND HEMORRHAGIC INFILTRATION

When the torsion occurs in the inguinal canal with the testicle lying either within the canal or at the external ring, it may be quite difficult to distinguish the condition from epididymitis, strangulated hernia and neoplasm because of inability properly to palpate the affected organ.

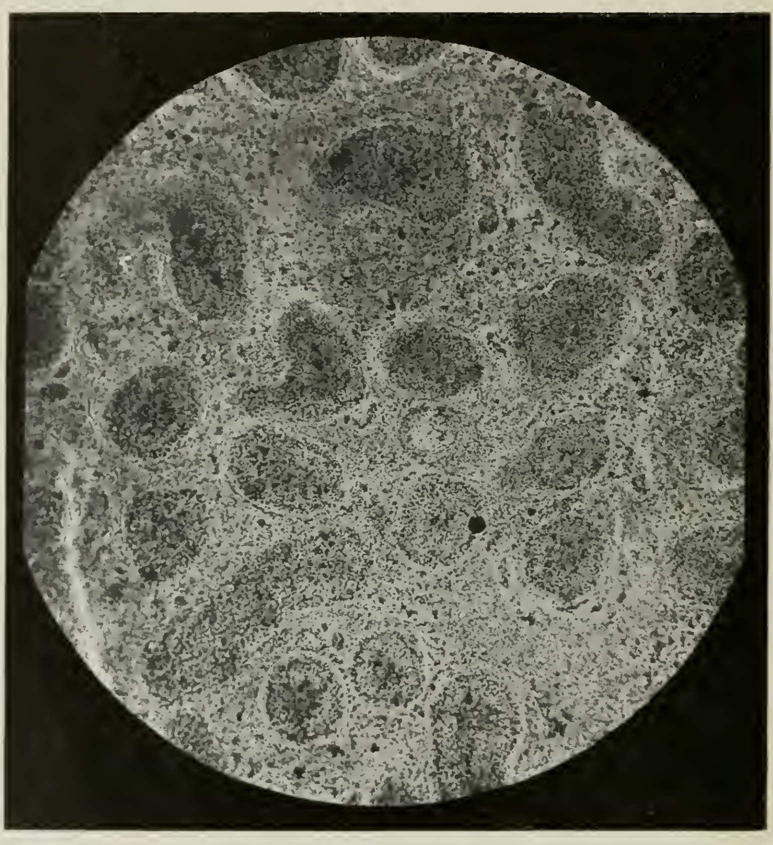

Fig. 3. J. G., Photomicrograph of Testicle Removed for Torsion of the Spermatic Cord, Eight Days After Onset of Pain in Scrotum
The tubules are all necrotic and present a picture of complete gangrene.

It is to be remembered, however, that strangulated hernia is unusual in youth, and that this condition characteristically produces grave systemic shock, and absolute obstipation, together with rapidly increasing intoxication of the patient, all three of which are absent in cases of torsion, where on the contrary the acute symptoms occur very suddenly, and then proceed rather to diminish than to increase. The inflammatory conditions of the testicle in this region may be distinguished best by elimiminating gonorrhea and examining the contour and secretion of the internal genital organs.

We diagnosed 1 case of neoplasm of the inguinal testicle as a torsion. Both testicles were in the groin, and on the left side the organ was swollen to the size of a hen's egg, and tender, with hydrocele fluid present anteriorly. The patient alleged that this condition had lasted only ten days, and there were gonococci in the urethral smear. Acute epididymitis and torsion were considered in the diagnosis, but operation revealed neoplasm.

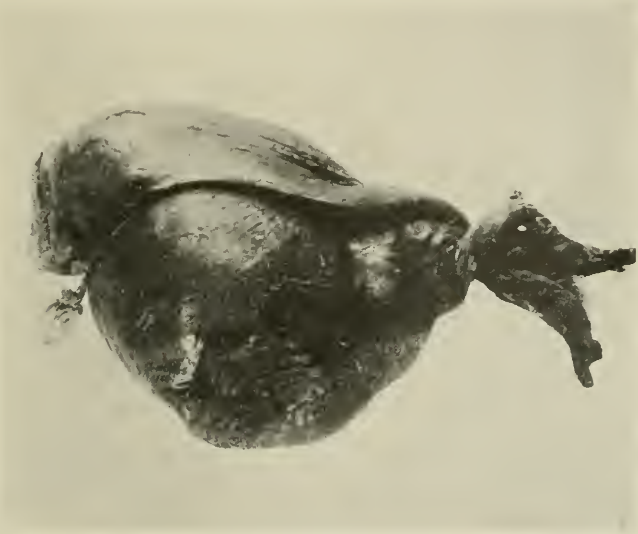

FIG. 4. DOG 1, GANGRENE OF TESTICLE
Torsion of the spermatic cord for seventy-two hours, the twist being just above the testicle and spididymis.

PATHOLOGY

The torsion of the spermatic cord occurs usually, if not always, just above the testicle, though secondary infiltration of the surrounding tissues may obscure the exact condition if operation is deferred. Such was the case in 2 of our patients.

The cord below the point of torsion is bluish black or gangrenous, swollen, edematous, while above it is normal or slightly edematous.

The testicle and epididymis are swollen, bluish black or gangrenous.

The tunica vaginalis contains a small amount of bloody serum. This has been regarded by some observers as pathognomonic.

On section the testicle and epididymis resemble an organized blood clot; the vessels of the cord are thrombosed. Microscopically there may be: first, hemorrhagic infarction; second, interlobular hemorrhage or, third, atrophy. Some cases have shown complete absence of normal testicular cells; 86 per cent of unoperated cases become gangrenous (4); the remainder atrophy to a greater or less degree.

PROGNOSIS

Cases of torsion seen early and corrected by surgical interference may be saved the end stage of gangrene, but they will atrophy. One of our cases that had not become gangrenous, later atrophied to about half the size of its fellow within one month after operation (suturing to bottom of scrotum). Another was not appreciably atophied in six months.

PROPHYLAXIS

At the time of operation for torsion the other testicle should be sutured to the bottom of the scrotal sac. This was done in 2 of our cases by delivering the testicle through a scrotal incision and suturing the tunica albuginea or the globus minor to the most dependent portion of scrotum after inversion of the vaginalis to prevent hydrocele. Cases of undescended testicle should be operated upon before the age of puberty and the testicles sutured well to the bottom of the scrotum to prevent torsion.

TREATMENT

The treatment is wholly surgical. Even the mildest torsion merits untwisting and fixation by suture. When seen within the first few hours an attempt should be made at operation to untwist the cord. If the testicle and epididymis appear viable, i.e., if they have not reached the bluish black stage and the cut surface bleeds, they should be untwisted and fixed to the scrotum after inversion of the tunica vaginalis. Those cases seen after forty-eight hours in which the testicle and epididymis appear gangrenous at operation must be treated by orchidectomy. To date no operative deaths are recorded.

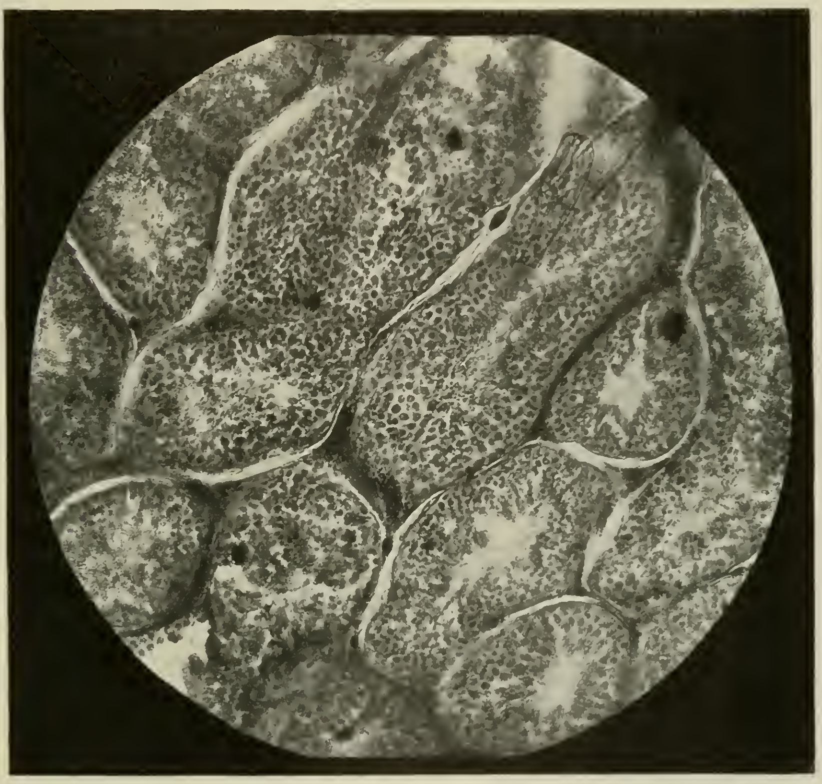

FIG. 5. PHOTOMICROGRAPH OF NORMAL DOG'S TESTICLE

Tubules of testicle were preserved; little spermatogenesis

EXPERIMENTAL WORK

Dog 1. Left testicle delivered and twisted 360° to left after cutting gubernaculum, and sutured to bottom of scrotum. Plaster cast. Orchidectomy seventy-two hours later. Gangrene.

Dog 2. Right testicle: ligation of whole spermatic cord. Left testicle: twisted 360° to right. Orchidectomy after forty-eight hours. Gangrene.

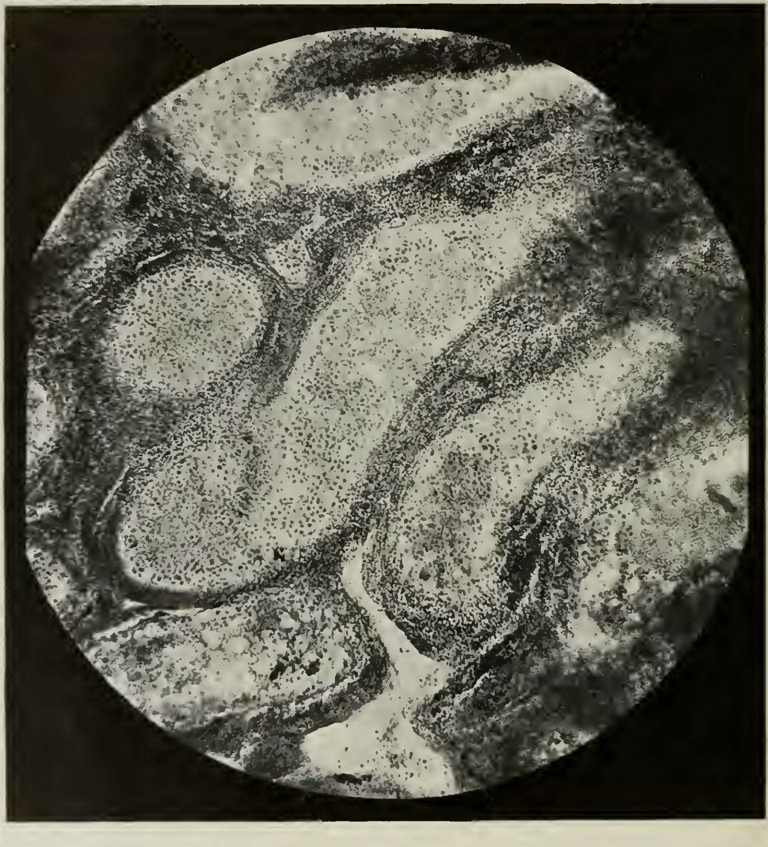

Fig. 6. Dog 3, Photomicrograph of Testicle Forty-Eight Hours after Torsion, Showing Partial Gangrene of Tubules of Testes with Hemorrhage and Edema

Dog 3. Right testicle: twisted to left 540°. Left testicle: twisted to left 630°. Orchidectomy forty-eight hours later. Partial gangrene.

Dog 4. Right testicle twisted to right 360°. Left testicle twisted to left 360°. Untwisted forty-eight hours later. Orchidectomy at end of ninety-six hours. Gangrene.

Dog 5. Left testicle twisted to left 540°. Right testicle twisted to right 540°. Three weeks later palpation of scrotum almost complete atrophy of both testicles.

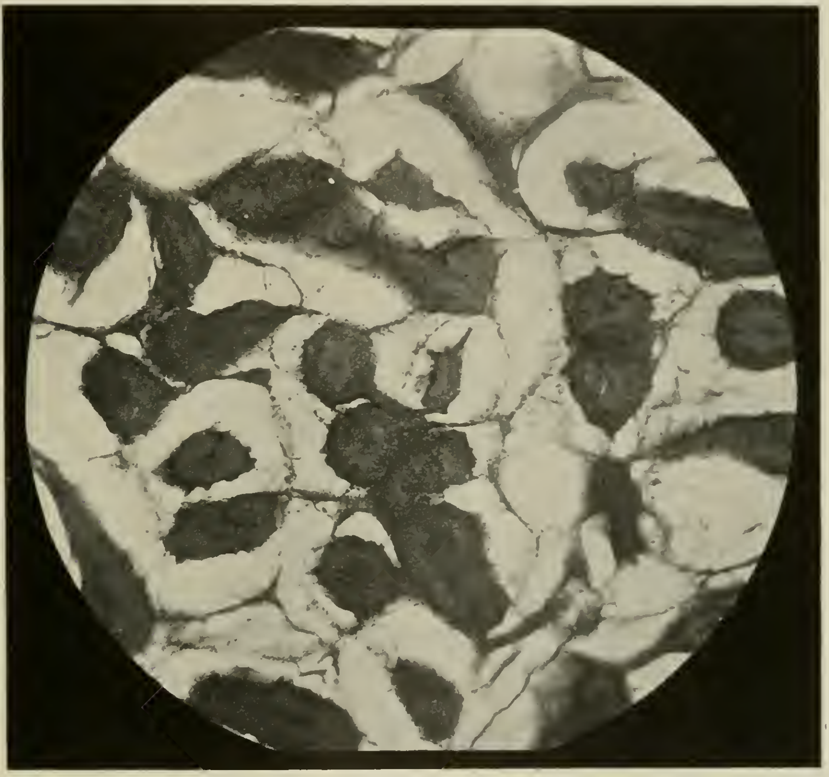

FIG. 7. DOG 4, PHOTOMICROGRAPH OF TESTICLE FORTY-EIGHT HOURS AFTER TORSION; THE TESTICLE WAS THEN UNTWISTED AND LEFT IN THE SCROTUM UNTIL THE END OF NINETY-SIX HOURS

Complete necrosis of tubules of testes and epididymis with blood between; retraction to form numerous small interspaces.

CONCLUSIONS

1. Torsion of the spermatic cord occurs usually if not always in testicles that are at least abnormally mobile, and often ectopic.

2. The exciting cause is usually muscular strain, sometimes direct violence.

3. The torsion occurs just above the testicle.

4. The symptoms, at first acute, resemble (*a*) epididymitis, but for the relatively low temperature and absence of involvement of the vas and internal genitals, or (*b*) strangulated hernia, but for the absence of progressive and fecal vomiting, and of obstipation; and the absence of toxemia, though this may be masked for some days at least by the intense pain.

5. Unless the torsion is slight and promptly relieved the testicle becomes gangrenous (86 per cent) or atrophies.

6. Our experimental work suggests that gangrene occurs within forty-eight hours.

7. Manual untwisting has relieved 2 cases. The torsion recurred a number of times in these.

8. Prophylaxis consists in the fixation of all mobile testicles.

9. The treatment of torsion is prompt operation for (*a*) untwisting and fixation of the testicle if viable, (*b*) orchidectomy, if gangrenous, and (*c*) fixation of opposite testicle if this is mobile.

CASE REPORTS

J. G., twenty-three years, laborer, admitted Ward K4, Bellevue Hospital, September 18, 1920.

Previous genito-urinary history. No venereal disease or urinary disturbance.

Present illness. September 13, 1920, at 3:30 p.m., while lifting a heavy can of cream, patient noted a sudden sting in left testicle. Kept on job till 5 p.m. although testicle was stinging. Pain in testicle most of night: tried to work next day, but was unable due to sick feeling in stomach, cold sweat and painful swollen testicle. In bed with ice bag and legs drawn up fairly comfortable for the next four days.

Physical examination. Patient does not appear acutely ill.

Local condition. Left side of scrotum about three times usual size, skin is red and edematous; unable to differentiate testicle from epididymis or identify definitely any portion of scrotal contents. Cord and vas deferens do not feel increased in size. Right scrotal contents normal.

Rectal examination: prostate and seminal vesicles normal.

September 21, 1920, orchidectomy for torsion. Incision anteriorly left side of scrotum. Testicle and epididymis were very dark brown as if gangrenous and the twist of the cord causing the gangrene could be distinctly seen ½ inch above the point where the vas connects with the epididymis. The upper pole of the epididymis was turned inward to make it occupy the normal position. Orchidectomy in usual manner. Temperature before operation 97°; pulse 86. Temperature after operation, maximum 100.4°; pulse 88. Hemorrhagic infiltration into the testicle and epididymis with gangrene. Urine, no infection. Discharged August 28, 1920.

Follow up. Letter October 22, 1922, states that he is feeling well and is at work.

S. B., fifteen years, school boy admitted Bellevue Hospital, Ward K4, December 22, 1919.

Previous genito-urinary history. Negative.

Present illness. December 13, 1919, while playing basket ball noticed a sudden sharp pain in right scrotum; had to quit playing, walked home. In the evening the testicle was swollen more and the pain "stronger." Next day he tried to play basket ball again, but pain was too severe. Since the onset and up to the admission date the pain in the testicle has been more or less constant.

Physical examination. Patient in bed does not appear in pain.

Local condition. Right side of scrotum about five times usual size: skin is red and adherent to testicle at lower portion. Testicle and epididymis can not be differentiated, testicular sense diminished. Cord is size of little finger, very firm and somewhat tender; left scrotal contents normal.

Rectal examination. Negative. Operation, December 30, 1919, for torsion of spermatic cord. Usual incision over right spermatic cord and upper scrotum. Tunica vaginalis very adherent to testicle but contained no fluid. It was easily dissected from the testicle and the part of cord within the tunica exposed to view. Here was a definite twist at 360°. Because of age of pathological condition it was not possible to untwist; the torsion was such that the outer part of the testicle had come forward and inward. The testicle and epididymis were cut into; both found to be almost black. The testicle, as a whole, stripped free from scrotum with remarkable ease. The gubernaculum was either very weak or absent. Entire mass excised in usual manner.

Pathological report, no. 8464, gross specimen is a testicle 4 x 2 x 2.5 cm. with a thick, partly hyaline tunica and an epididymis 3 x 1 x 0.5 cm. Both testicle and epididymis are dark blue in color, hemorrhagic and almost gangrenous from torsion, no microscopic.

Diagnosis. Torsion of testicle stalk with resulting necrosis. Urine normal. Temperature before operation, 99.2°. Temperature after operation 100°, maximum. Pulse, 70 to 86.

Discharge note. Wound healed per primum.

Readmission January 20, 1920. Operation, herniotomy. Left indirect inguinal hernia. Left inguinal incision down to cord. Hernia sac found opened down to top of testicle. This was dissected up and excised; Bassini operation. Lower part of testicle was sutured to the lower part of the scrotum.

Discharge note. Wound healed per primum testicle fastened to bottom of scrotum.

P. S., twenty-three years, tailor, admitted Bellevue Hospital, Ward K4, September 9, 1920.

Venereal and past genito-urinary history. Gonorrhea three years ago. Says he has had swelling in right testicle since he was 16.

Present illness. Patient appears acutely ill.

Local condition. Right scrotum inflamed, swollen with induration and swelling of cord. Epididymis not made out as distinct from testicle. No fluctuation made out. Moderate urethral discharge; smear shows intracellular diplococci.

Diagnosis. Acute gonorrheal epididymitis.

Operation. October 19, 1920. On cutting down through the right scrotal sac to tunica vaginalis, dark colored material, apparently blood, could be seen through the thin tunica. Testicle and epididymis easily delivered through the wound, no gubernaculum being found. The tunica vaginalis was opened, and the epididymis and about one-half of the testicle found to be black, apparently gangrenous. A definite twist of the cord was found just above the testicle. Cord ligated in region of external ring and cut across.

Discharged. September 26, 1920. Wound clean. Urine, pus and tuberculosis. Albumin, faint trace. Temperature, 99.2° before operation. Temperature maximum, 100° after operation. Pulse not above 88. Hemorrhagic infiltration into the testicle and epididymis with gangrene.

M. M., sixteen years, helper, admitted Bellevue Hospital, February 25, 1921.

Previous genito-urinary history. Gonorrhea seven months ago; treated by doctor.

Present illness. While carrying a basket of images, February 22, 1921, patient noticed a pain in right testicle; did not vomit, felt sick in head and all bones and joints. Continual pain in testicle until evening of February 25, 1921, when ice bag gave relief.

Physical examination. On admission a well nourished boy, in bed, not acutely ill.

Local condition. Right side of scrotum about twice size of left, skin is red (slightly) anteriorly. The right cord is not tender, the vas and remaining structures apparently normal to palpation. The right testicle is about twice the size of the left, rather painful on pressure, the globus major of the epididymis is enlarged several times and very painful. History of both testicles going up to the external ring very easily. Left testicle can certainly be pushed up to external ring now. March 3, 1921, medical consultation, head and chest negative. No exploration for high temperature. White blood cells, 9400. Blood culture, sterile. Urine, free from infection. Operation, March 5, 1921. Vertical incision right scrotum. Testicle delivered through this; tunica vaginalis incised and inverted. Testicle found to be enlarged with marked congestion of vessels below the tunica albuginea. Torsion of the cord looked for, but not found. No evidence of epididymitis. Gubernaculum was found to be about three inches long and was plicated by a chromic gut suture. Left scrotum opened by a smaller incision. Vaginalis everted and gubernaculum plicated, this gubernaculum being as long as the other; testicle normal. Temperature, maximum before operation, 104°; temperature, maximum after operation, 104°. Pulse from 76 to 104.

G. McN., fifteen years, school boy. Patient of Dr. A. Raymond Stevens. Seen December 20, 1920.

Previous genito-urinary history. Negative.

Present illness. December 8, 1920, was seized by a boy who squeezed testicles between both hands. After few minutes pain became bad and quickly very severe. Scrotal mass was needled twice at school. Came to New York three days ago.

Local condition. Swollen left testicle, very hard with redness anteriorly. Today had temperature of 105°, and chill; 104° at time of my visit; pus oozing from one of puncture wounds.

Operation. December 21, 1920. Anterior incision, excising area of gangrene, size of nickel in scrotal wall. Abscess 3 cm. in diameter under skin, perforates tunica vaginalis to space below. On opening tunica, testicle and epididymis found gangrenous with twist of over 360° of cord, within tunica. Skin incision carried higher, cord tied and cut excising whole mass. Drain to scrotum.

Follow up. January 5, 1921, patient home on December 24, out of doors on December 29. There has been much discharge from scrotum and end of cord. Today scrotum has scarcely any discharge.

V. F., sixteen years, package maker, admitted Bellevue Hospital, May 2, 1921.

Previous genito-urinary history. Negative.

Present illness. Day before admission about twenty hours ago, patient jumped and felt pain in left scrotum. This became swollen and very tender. Had no bowel movement after this happening.

Physical examination. Undernourished boy in pain.

Local condition. Left scrotum is swollen and very tender. There is thickening of structure passing through ring. Attempt at reduction fails and causes pain in left side of abdomen. Mass is larger when patient stands. Abdomen is distended and tympanitic. Operation, May 3, 1921. On splitting the external oblique aponeurosis the cord was seen to escape beneath the conjoined tendon and was a purplish red, deeply congested, swollen, edematous in appearance, simulating the beginning of gangrene. As far as could be ascertained these parts extended down toward the scrotum. It was believed at first to be a strangulated hernia, but after long and tedious dissection it was found to be similar to elements of the cord, and high up on the inner aspect of the cord with traction on it, a small peritoneal sac was brought down, opened and with finger in the peritoneal cavity, absolutely no hernia was found. This small protrusion was ligated, and dropped back. A segment of about 2 inches of the edematous, gangrenous appearing vessels of the cord were then excised, care being taken to maintain the continuity of the vas. Ferguson type repair. Maximum temperature before operation, 99.4°. Maximum temperature after operation, 100.4°, Pulse, 72 to 84. Urine negative.

Discharge note. May 17, 1921, patient ran uneventful course post-operation. His testicle swelled up and subsided rapidly so that it was only slightly larger than normal on discharge.

Follow up. November, 1921, testicle feels normal.

L. A., twenty-three years, salesman, admitted Bellevue Hospital, January 23, 1922.

Past genito-urinary history. Negative, except that the patient had known for years that he was ruptured and had an undescended testicle on the right side.

Present illness. Three hours before admission, cramp-like pains in the right inguinal region. Pain radiated through abdomen. Felt nauseated, but no vomiting. Bowels regular.

Local condition. Right testicle halfway down inguinal canal apparently swollen and tender. Just above this and outside of internal ring is a hard mass that is tender. There is a definite impulse below testicle, but apparently no intestinal contents.

Operation. January 23, 1922. Under ether anesthesia, incision carried down over Poupart's ligament. External oblique opened exposing testicle and veins. Veins greatly enlarged with dark blood and thrombosis. With pedicle at internal abdominal ring the testicle and veins were twisted one and one-half times causing the torsion and strangulation. Sac opened, vas and veins cut across at internal ring. Hernia repair after usual Bassini method.

Pathological specimen, no. 768, *gross* testicle and epididymis darkly discolored and portion of sac. On section the testis and epididymis are densely infiltrated with blood and the latter is considerably swollen and edematous.

Microscopic. Extensive infiltrations of blood throughout testis and epididymis, the intertubular tissues. Tubules well preserved. Blood vessels around epididymes distended. No organized thrombosis.

Discharge note. February 8, 1922, patient made uneventful recovery. No complications from thrombosis of apermatic veins inside abdomen. Wound closed per primum.

Follow up. April 6, 1922, inguinal region solidly repaired. Patient has no complaint. Left testicle in the scrotum; it can easily be pushed up to the external ring. Advised to have testicle sutured to bottom of scrotum.

Cases V. F. and L. A. are reported with our cases through the courtesy of Drs. Bradley Coley and Fenton Taylor.

REFERENCES

(1) Van der Poel: N. Y. Medical Record, January, 1895.
(2) Smith, G. G.: Cabot Modern Urology, 1915, 444.
(3) Edington: Lancet, 1904, 1782.
(4) Rigley and Harard: Lancet, 1907, 1, 1416.

INFECTION OF THE SEMINAL VESICLES IN RELATION TO SYSTEMIC DISEASE[1]

FREDERICK W. SMITH AND JOHN H. MORRISSEY
New York

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Surgical attack on the seminal vesicles has been restricted by two facts: first, uncertainty as to the value of operative interference and second, the lack of a suitable surgical technique combined with inaccessibility of the organs. In this respect it shares with perineal prostatectomy a disfavor due to the anatomical considerations involved.

In the early reports on the surgery of vesicular infections, classes requiring operative treatment were divided into four groups as follows: (1) The inflammatory group embracing those presenting acute suppurative symptoms of both the vesicles and the prostate; (2) the rheumatic group including those with joint, tendon, muscle and bone manifestations dependent upon a local infection; (3) the pain group which covered the cases presenting more or less persistent perineal pain—vague bladder symptoms—rectal symptoms and unclassified sexual symptoms such as painful erection, bloody emissions, painful intercourse, etc., and (4) the neurasthenic group which covered cases with but moderate physical findings of disease in the vesicles—but showing however, mental symptoms in the nature of depression, melancholia and apprehension—the so-called sexual neurasthenia.

In commenting upon the occurrence of these neurotic symptoms a comprehensive review of 1000 cases recently presented stated that neurotic symptoms were common in 80 per cent of all cases. The degree bearing from a mild state of apprehension to one of suicidal intention. Quoting farther from the article this condition was considered one of the most serious phases of vesicular infection. The extreme cases were considered not only a danger to themselves but a menace to the community, particularly to the attending physician. Cases of suicide attributed to vesiculitis of the neuro-sexual type were recounted and the opinion was expressed that the neurotic state was due to the prolonged course of the disease, persistency of symptoms, prolonged course of treatment and lack of encouragement. The multiplicity of seminal vesicular symptomotology is a term frequently used and serves well to explain the variety of symptoms referable to these organs.

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[1] Read at the meeting of the American Urological Association, Atlantic City, New Jersey, April, 1922.

To these classified four groups we have added a fifth: the graver forms of mental disorder—the psychotic group and our operative experience with these cases forms a large percentage of our series.

Treatment of the insane in the New Jersey State Hospital where we have a urological service has been along the lines of a search for a focus of infection as a possible cause for a psychosis. In a review of the Hospital report, recently published, the spontaneous recovery rate for the decade prior to 1918, was only 37 per cent. Since then and as a result of instituting a detoxication treatment the rate has reach 77 per cent. This total, however, comprises a large series of cases and includes but a small number of those in which the focus of infection had been considered as existing in the vesicles. Infected teeth, tonsils, sinuses, gastro-intestinal systems, etc., were all found to have contributed to the etiology of the psychoses and having received surgical attention, the cases have improved sufficiently to be freed from confinement.

It is no new theory that infection and toxemia can cause mental disturbance, for psychiatrists have, for many years, classified such disturbances under the specific term "toxic-infectious psychosis." The diagnosis was, however, limited to a small group of cases in which from the acute nature of the infection its presence was readily recognized by routine examination.

In 1908 Henry S. Upson of Cleveland called attention to the relation of infected teeth to mental disorders and Savage, the English alienist, as far back as 1876, reported several cases of acute mania recovering suddenly after the extraction of bad teeth. In 1912 Billings called attention to the relation of infected teeth to arthritic conditions and later Hastings and Rosenow also published conclusive studies in the same field. In the acute psychoses the mental function has been disturbed as is evidenced by the delirium in fever, delirium tremens, etc. When the physical cause or toxin or the alcohol has been eliminated while the brain has become seriously affected it becomes perfectly normal again.

Cotton suggests a diagnostic survey of the psychotic patient by all methods such as X-ray, bacteriological and serological examinations, in conjunction with a careful history and a thorough physical examination. By these means chronic focal infection is often discovered. Many chronic infections originate in the oral cavity and specifically around the teeth and tonsils and from these foci the bacteria migrate to different organs or through systemic intoxication affect different systems, the latter especially true of the nervous system in the causation of functional psychoses.

In brief the theory of infectious psychoses may be summed up as follows: "Toxic effects whether produced by alcohol or bacterial infection may be temporary or permanent. Thus in delirium tremens we have a profound mental disturbance which disappears after withdrawal of alcohol."

This brings us to a consideration of focal infection in the seminal vesicles less frequently the prostate gland. Chronic infection of the urogenital tract may serve as a source of constant or intermittent supply of pathogenic microörganisms producing metastatic infection in distant organs or a toxemia in other systems. Bearing in mind the knowledge of the rôle of the seminal vesicle in arthritis and the cases included in the various groups, routine examination of the seminal vesicles and prostate was instituted in the treatment of all patients admitted to the Hospital. We were impressed from the beginning with the large percentage of cases in which the vesicles were palpably pathological, and with the presence and diversity of bacteria in the secretion expressed from them.

Operative treatment was instituted with three purposes in view: (1) vesiculectomy—restricted to those cases where on exposure of the vesicles a marked local inflammatory reaction of long standing was noted. This can be made out by the marked acute or chronic infiltration of the area and a distinctive peri-vesiculitis in which the vesicles instead of stripping away easily, once the fascial planes have been removed, are cemented as it were, to the base of the bladder. It is in these cases that on cystoscopic examination a severe trigonitis is the only pathology discernible to explain the bladder symptoms. A few cases are recalled where a well defined area of inflammation in the trigonal region roughly followed the shape of the underlying vesicle and the diagnosis was quite evident but frequently th's fact is entirely overlooked. Inspection of the vesicles in the operative field surrounded by a deep infiltrating cellulitis leads one to a keener appreciation of how bladder symptoms may be the direct result of the vesiculitis without an associated or active posterior urethritis. (2) Vesiculotomy—done in the cases where the vesicles could be easily mobilized and brought into view without destruction or injury and where there were no gross changes in the vas. Care was taken to provide adequate drainage by free incision and to open all diverticula as cautioned by Watson. (3) Prostatotomy—in itself one of the most important steps of the procedure. The prostate was liberally incised and small sections taken for verification of diagnosis. Operation in cases of the first four groups was for persistence of symptoms and lack of response to the usual methods of treatment.

TECHNIQUE

Our operative procedure in detail is as follows: With the patient in the exaggerated lithotomy position as for perineal prostatectomy, a curved sound is introduced into the urethra. An incision, curved anteriorly, is made from the tuberosities of the ichsium—care being taken to carry the center of the incision deeper than the remainder in order to gives a better base for healing of the flap. The central tendon is divided in the usual manner and by careful sharp dissection the bulb exposed. This is retracted and a similar retractor to that devised by Young is passed into the bladder and division of the recto-urethralis muscle is done usually with one finger in the rectum as at this point perforation of the rectal wall is most liable to occur. In

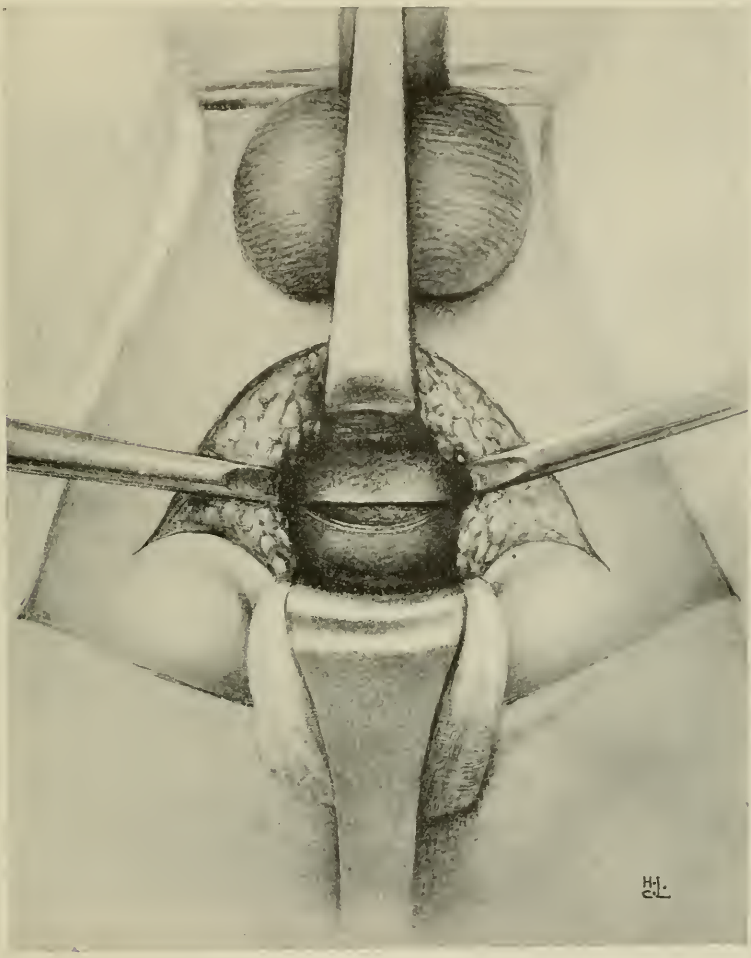

FIG. 1. SHOWING EXPOSURE OF PROSTATE WITH DIFFERENTIATION OF TWO LAYERS OF PROSTATIC FASCIAL

The true approach to the vesicles lies beneath this second layer and recognition of this anatomical fact is essential.

cases where for one reason or another the Young tractor cannot be introduced through the urethra, the membranous urethra is opened and the tractor introduced as in perineal prostatectomy. Following exposure of the entire surface of the prostate the fascia of Denonvilliers is divided transversely and division is further continued until the second layer of fascia is freed away and the index finger inserted posterior to this. Hugging the surface of the prostate one can then reach the tip of the vesicle.

Enucleation of the vesicle is then begun by careful blunt dissection and it is separated from numerous adhesions between the bases of the bladder—the accompanying vas and other surrounding structures. In no case have we ever had any occasion to consider possible injury to the ureter in this connection. If the obstruction in the vesicle is not marked it will frequently empty into the urethra under the manipulation and its removal becomes more difficult. In cases where vesiculectomy is contemplated a suture passed around the lateral portions of the ampulla prevents this emptying.

If vesiculoctomy is the precedure of choice the vesicles are liberally incised and the anteriors swabbed out with carbolic acid and neutralized by alcohol. Sections of the wall are taken for examination and specimens of the secretion for culture and smear. In excision of the vesicles they are cut away about 1 and 0.5 cm. from the midline and about 1 cm. external to the junction of the vas and ampulla. The cut end is swabbed with carbolic acid.

Rubber tube drains are then placed to the site of the vesicles and following liberal incision in the prostatic tissue, and removal of small sections for diagnosis, the divided fascia is loosely sutured to the upper portion, the free edges of the levator ani brought together with interrupted plain gut and the skin closure made with interrupted silkworm gut.

Attention is called to the method of dissecting away the rectum by gauze dissection with the index finger of the left hand in the rectum. This practically obviates the danger of injury to the rectum, the bugbear of perineal operations. In but 2 cases of the series was there injury to the rectum, and in these it occurred where the Young tractor could not be introduced through the urethra. Since that time we have not hesitated to open the urethra in the perineum and this so brings the prostate into view that the anatomical relation can always be appreciated.

Operative after care has consisted of removal of the tube drain in three days with frequent daily dressings. None of

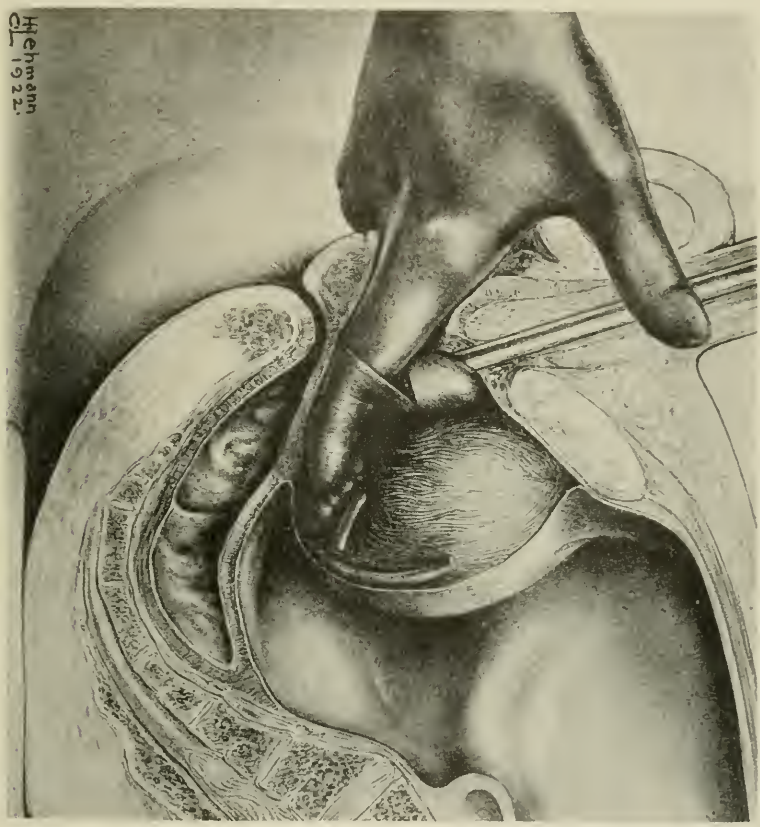

FIG. 2. SHOWING METHOD OF ENUCLEATION OF VESICLE ONCE THE PLANE OF THE VESICLES HAS BEEN REACHED

If adhesions are not too extensive the organs can be brought out and inverted as shown in next figure.

the cases have developed bladder symptoms of any severity and bladder irrigations are not required. All wounds have healed kindly excepting in a few cases where the triangular flap showed a tendency of the point of the wound to slough away. This is obviated by the curved incision. No cases have been complicated by hemorrhage or shock and the operation seemed to upset the patients less than many other surgical procedures.

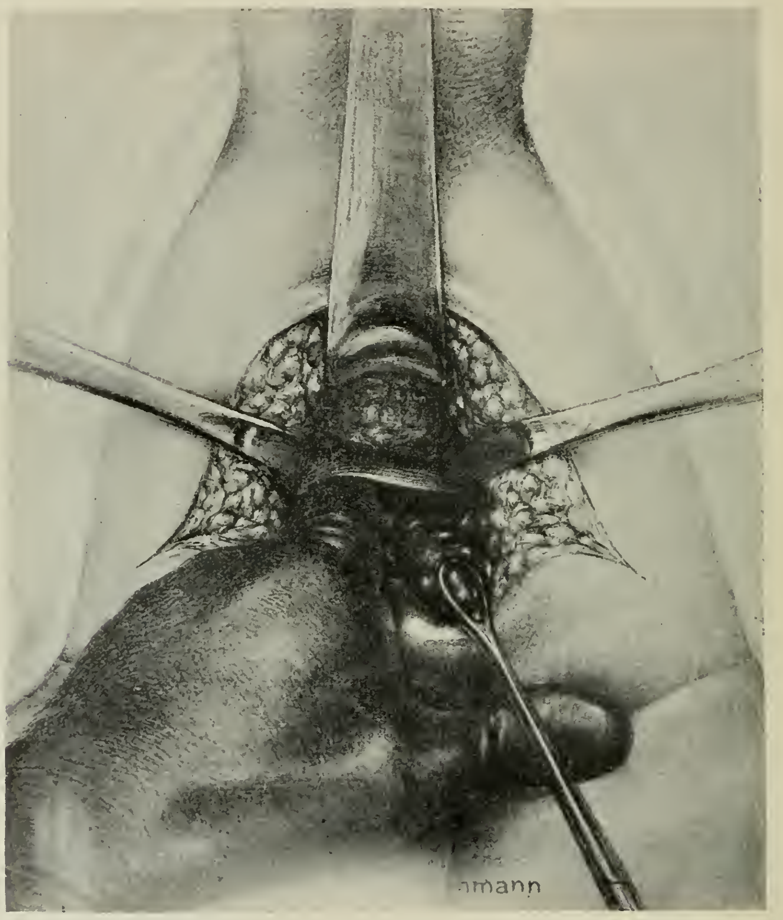

Fig. 3. Showing Delivery of Left Vesicle into Wound and Index Finger Enucleating Opposite Vesicle

Vesicle abnormal in size and grossly pathological

RESULTS

This report is necessarily a preliminary one as sufficient time has not elapsed to draw definite conclusions on all cases. We have operated on 77 cases. The mortality has been nil and the convalescence uneventful. In three cases the rectum was entered and immediately sutured and no further developments occurred. In our study of these cases our object has been to treat chronic inflammation which may be a focus of infection by recognized surgical methods.

In the pus group, 6 cases in all, the end results are those usually obtained after thorough drainage, viz., rapid healing and shortened convalescence. In the rheumatic group of 12 cases, 9 were immediately relieved of pain and bony changes were not noted in 6. Three were not entirely relieved. These cases showed joint changes before operation.

In the pain group of 2 cases 1 showed calculi in addition to infection, and both were entirely relieved by operation. In the neurasthenic group comprising 2 cases we found only slight improvement. In the psychiatric group of 57 cases—the first series comprised 24. Of these, 5 or 20 per cent were discharged as cured. Conclusions on the remainder cannot be drawn at this early date. The pathology in general showed chronic inflammatory changes with infiltration and plastic exudate and in some cases occlusion of the lumen of the canals of the vesicles. The bacteria most commonly found were various strains of B. coli, staphylococcus albus and different strains of streptococci, including hemolytic and various green producing forms. In no case was the gonococcus found.

CONCLUSIONS

1. The immediate relief of acute symptoms and shortened convalescence in our cases justify drainage of the vesicles.
2. The pathological findings in the vesicles demonstrate this inflammatory change and lack or destruction of function.
3. In the psychotic group operation should not be done until all other foci have been eliminated.
4. The percentage of cures, although small, however, merits consideration of seminal vesiculitis as a focus of infection and operative treatment on the vesicles in the cases falling in this group.

DISCUSSION

Dr. J. H. Morrissey, New York: The main point I would like to call attention to is the fact that we have not been operating on these insane patients to cure insanity, but rather to operate on the individual in whom there has been pathology. We have operated upon some fifty cases and 35 per cent of this number showed pathology in their vesicles on examination. Before operation it was noted that the vesicles would not empty on pressure and examination of the excretion showed a large quantity of pus and bacteria.

The technic used was much the same as that advised by Dr. Young. This procedure is facilitated, however, by identifying the second layer of fascia called attention to by Dr. Lowsley, which covers the vesicles. If this is sectioned, the vesicles can be enucleated much more easily. Before we did this, attempt at enucleation has often resulted in our rupturing the vesicles at the tip and spilling the contents in the post-prostatic space. This seemed to make the convalescence longer.

Occasionally much difficulty is had in introducing the Young tractor through the anterior urethra and in fact, one case where we entered the rectum was where I could not introduce the tractor. Since then I have been introducing the tractor in the posterior urethra just as in perineal prostatectomy and the results are just as satisfactory.

We have been treating pathology in the insane and not the insanity. In the group of cases of which 5 per cent showed improvement most of them had been diagnosed as dementia praecox. Many of these insane have infections in their teeth and sinuses, less frequently the gastro-intestinal tract. When these sites have been excluded or treatment of them ineffective they are referred to us and naturally the percentage of improvement is proportionately less.

Dr. A. L. Wolbarst, New York: In relation to the prostate and vesicles in the so-called insane, about ten years ago I made a serious effort to study a large number of cases at Central Islip State Hospital and found that in many of these cases the prostate and seminal vesicles were affected. It was of the opinion of some of the alienists that these men were not really insane but were suffering from a toxemia which we thought was referable to the prostate and seminal vesicles. At that time we had no facilities for surgical treatment for them, but my observations lead me to confirm Dr. Morrissey's findings. In the case of one man who had been in the institution thirty years, gonococci were found in the prostatic secretion. That was the report of the pathologist, although I found it hard to believe.

Dr. J. D. Barney, Boston: I wish to show a specimen of torsion of the testicle which bears upon Dr. Keyes' paper. It is unsatisfactory because the specimen is hardened and will give a little different appearance from the actual conditions. I will make a diagram on the board which will illustrate the condition. On opening the tunica the upper pole of the testicle and epididymis and the hydatid of Morgagni presented, all being gangrenous. The lower pole of the epididymis and the body, being attached to the testicle by a long, loose mesentery had been turned upward and had twisted themselves around the entire spermatic cord in clock-wise direction, making about one complete turn which was cleared by the spermatic cord as well.

This may be a common occurrence but I have not seen it and it showed up very clearly.

Dr. Gideon Timberlake, Baltimore: I wish to commend Dr. Keyes' paper very highly. I have been most interested to know whether the gonads directed their torsion outward or inward; further, I would like to know whether he believes the direction of rotation is affected by shifting of the centre of gravity of these organs wherein inflammatory processes are found about the upper poles.

Dr. Max Lauterman, Montreal: I wish to add to Dr. Timberlake's appreciation of Dr. Keyes' article. I have had the good fortune to have seen at least half a dozen cases of torsion in the last few years. The first point was the number of these cases that have not the gangrenous atrophy. One case was interesting from the fact that the torsion had existed for five days before I saw the patient, but it was ultimately relieved without any deleterious results.

The question of the degree of interference with the circulation is paramount. When the organ is cyanotic or gangrenous, just as in the belly, nothing can be done for it. But I think Dr. Keyes' statement of the fact that forty-eight hours represents the average period which the testicle will stand a deprivation of its blood supply is rather on the generous side, but that does not invalidate the fact that I think is of great importance, and that is the degree of twisting which governs the interference. I know of at least one case in which five days of interference was not sufficient to destroy the organ.

I think the contribution is a distinct addition to our knowledge of the subject.

Dr. Thomas F. Laurie, Syracuse, N. Y.: I just want to ask Dr. Keyes if there was any involvement of the scrotum in the gangrene?

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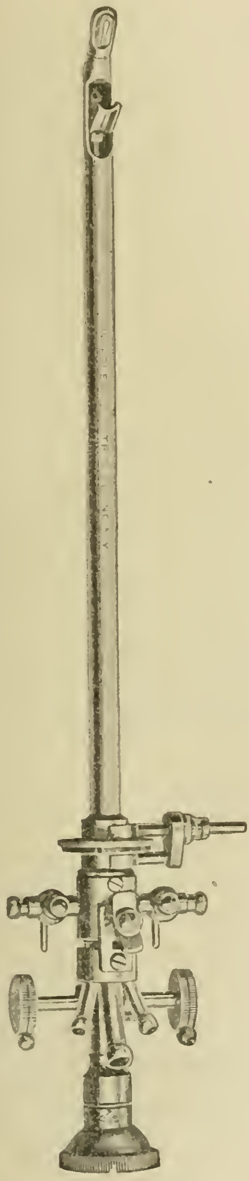

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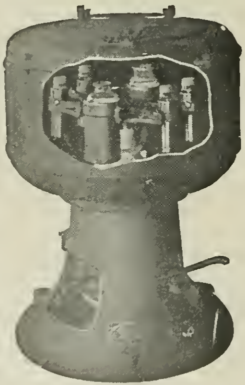

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TUBERCLE BACILLUS INFECTION AND TUBERCULOSIS IN MAN AND ANIMAL

BY

ALBERT CALMETTE

Associate Director, Pasteur Institute, Paris

Authorized Translation by

WILLARD B. SOPER, M.D. *Saranac Lake, N. Y.* AND GEORGE H. SMITH, PH.D. *Yale Medical School*

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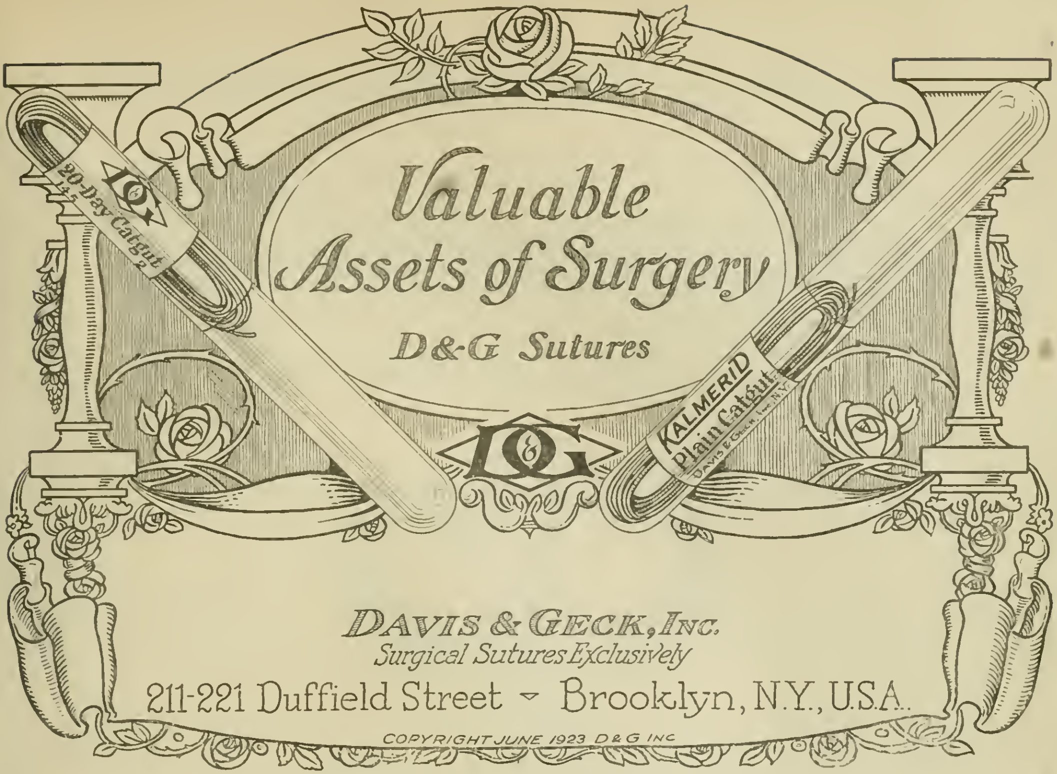

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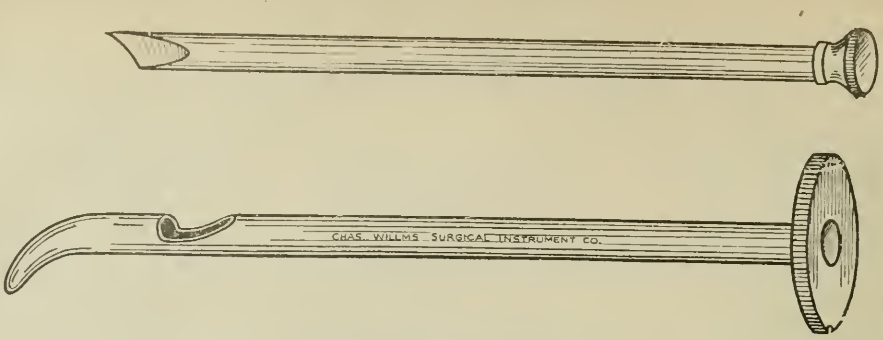

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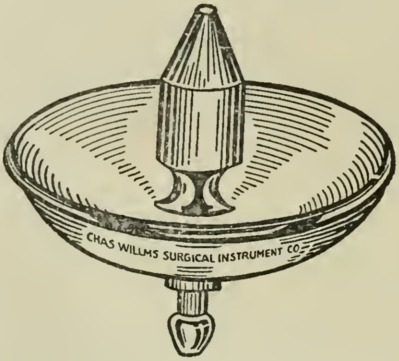

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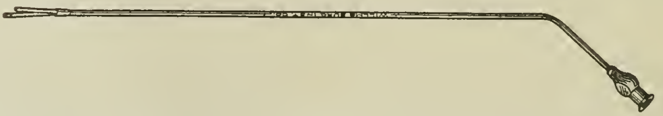

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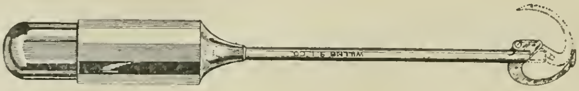

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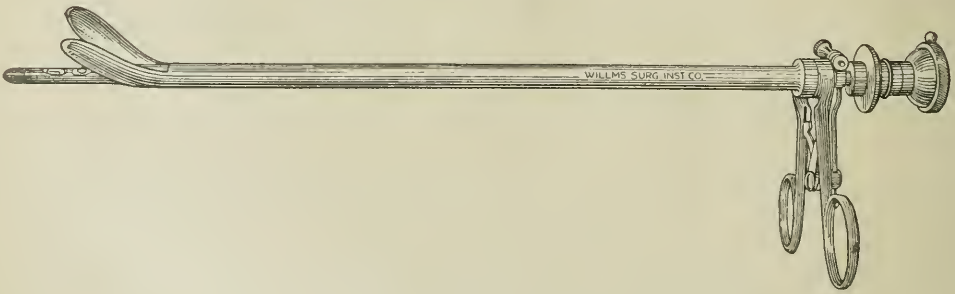

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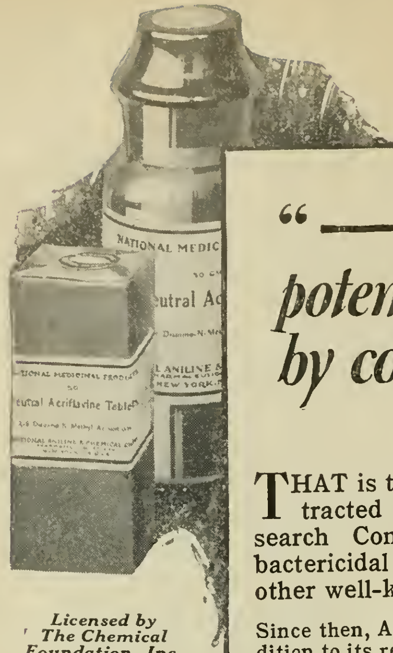

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